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JOURNAL
OF THE
BOMBAY NATURAL HISTORY SOCIETY

2019 VOL. 116

BNHS INDIA CONSERVING NATURE SINCE 1883

JOURNAL OF THE BOMBAY NATURAL HISTORY SOCIETY

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Cover Photograph: *Badis badis*
by Unmesh Katwate

ACKNOWLEDGEMENT

We are grateful to the Ministry of Science and Technology,
Govt. of India,
for financial support for the publication of the *Journal*.

Editorial

Birds of a feather

Birds of a feather flocked together at Lonavala, Maharashtra from November 18 to 22, 2019 for the BNHS's International Conference on 'Wetlands and Migratory Waterbirds of the Asian Flyways', organized jointly with MoEF&CC and BirdLife International. After a year of dedicated team work, BNHS was able to gather an assemblage of 280 scientists, academia, conservationists, state forest officials, and decision makers from 18 countries to review the current status of migratory waterbirds and conservation issues of the wetlands of the Central Asian Flyway (CAF).

Presentations and deliberations at the various sessions assessed the threats confronting wetlands and waterbirds of the CAF region, including loss/degradation of habitats, competing use of habitats, changing climate, lack of adequate water allocation to maintain wetland character, pollution, energy and linear infrastructure development, and also the threats posed to birds from free-ranging dogs. Collaborations between various countries and organizations along the Central Asian Flyway stretching from the Arctic region to the Indian subcontinent, helped in gathering evidence to substantiate the rapid decline in many migratory bird populations and ascertain causes of the declines. The aim of this conference was to arrive at an agreement on priority conservation actions that could be implemented to address the problems facing wetlands and migratory waterbirds. A resolution from the conference will be placed at the upcoming 13th Conference of Parties (COP) of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) being hosted by India on February 15–22, 2020 at Gandhinagar in Gujarat.

The illegal Indian bird trade

Reflecting on the five wonderful days of learning and sharing of work experiences and ideas with researchers, conservationists and experts, one theme that particularly comes to our minds is the illegal trade of birds in India.

The Wildlife (Protection) Act, 1972 (WPA) that safeguards India's wildlife and habitats is, in general, one of the finest Indian laws. In the past, India was a major bird export country. With an interest to especially conserve India's avifauna, the Government of India imposed a blanket ban on the export and domestic trade, hunting, and trapping of wild native birds, with a subsequent amendment in the WPA in 1990–91.

Despite the ban on such illegal activities for over almost three decades, TRAFFIC India studies revealed that out of 1,300 bird species recorded in India, 453 species are reported in domestic and international bird trade. Birds are trapped to be traded for the pet business, meat, aviculture, zoos, 'merit-release', medicinal use, sport (bird fights and falconry), black magic and sorcery, for street performances, and for other uses of their body parts, including feathers. It is most surprising to know that not less than 23 Threatened and 19 Near Threatened species of birds are victims of this illegal bird trade. Some tribes and rural communities in India, such as the Baheliyas and Mirshikars, still depend heavily on wildlife resources for sustenance and income generation.

In the domestic bird markets, there is no restriction on the sale, purchase, and rearing of exotic birds within the country. Although India is a signatory to CITES which is enforced through the Indian Customs Act at international transit points, there is no provision for the enforcement of CITES through the WPA.

doi: 10.17087/jbnhs/2019/v116/149827

Hence, CITES-listed exotic birds are smuggled within Indian boundaries, making India a hub for trade in several non-native exotic birds, an issue that needs to be looked at.

Nevertheless free trade in domesticated exotic birds such as budgerigars and Japanese quails should be freely allowed to release pressure on wild alternatives. What one needs to rethink is that proactive animal activism on domestic pet and table birds under cruelty norms is pushing bird trade back to wild birds such as waterfowl, waders, and galliforms which can be sold at a premium without open display.

Under the many resolutions passed at the conference, it was unanimously agreed to undertake a review of the scale, scope, and motivations of illegal bird trapping in India; to document the local and trans-boundary trade of migratory birds in the CAF; identify the key illegal poaching and trade locations in India; develop mitigation mechanisms to curb these activities through publication and distribution of identification manuals on species in the trade; to conduct wildlife law enforcement training workshops, and look at options for alternative livelihoods for traditional bird trapping communities/tribes. As part of this agenda, BNHS is in the process of establishing a Bird Crime Prevention Cell to work on grassroots-level solutions towards preventing the poaching and illegal trade in wild birds in India.

Deepak Apte and Abrar Ahmed

OCCURRENCE, DISTRIBUTION AND DESCRIPTION OF *LOXOSCELES RUFESCENS* (DUFOUR, 1820) (ARANEAE: SICARIIDAE) FROM WESTERN INDIA[1]

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[1]Accepted September 19, 2018
First published: May 2019 | doi: 10.17087/jbnhs/2019/v116/123017
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Loxosceles rufescens (Dufour, 1820), commonly known as the Circum-Mediterranean Spider, is medium-sized (7–8 mm), light to medium brownish with long and slender legs; its bite is mildly harmful to humans. *L. rufescens* is a relatively cosmopolitan, synanthropic species with mildly toxic venom which can occasionally cause dermatological injuries in humans. Its native range covers the Mediterranean Basin and Near East. The present communication highlights the biological identity, habitat preference, and distribution of *L. rufescens* in Western India. Spider diversity survey was carried out from July to December 2015, and October 2016 to February 2017. The population of *L. rufescens* largely (N=51) occurred in residential and University-PG Department buildings in Kathiawar (districts Amreli and Rajkot), Gujarat, Western India. In these buildings, its microhabitats included corners of walls, storage boxes of books, unused wooden and steel cupboards and their crevices, with irregular webs, typically in close association with Common Indian Black Ant and Common Indian Large Ant.

Key words: *Loxosceles rufescens*, biology, human habitations, distribution, toxic, Western India

INTRODUCTION

The venomous six-eyed spider family Sicariidae is notorious for its bites, which occasionally produce a suite of symptoms known as loxoscelism, characterized by severe necrotic dermatologic injuries (Swanson and Vetter 2006; Yigit *et al.* 2008) and are therefore of medical significance. This family is represented by three genera, *Hexophthalma* (6 species), *Loxosceles* (133 species), and *Sicarius* (21 species) around the world (World Spider Catalog Version 19.0).

The genus *Loxosceles* Heineken and Lowe, 1832 is characterized by slanted legs (Cameron 2005); most species are known as violin spiders or fiddleback spiders due to the distinctive dark violin-shaped marking on the cephalothorax. They are called recluse spiders in North America and brown spiders in South America. Most of the taxonomic literature on *Loxosceles* from 1834 through 1983 (Gertsch 1958, 1967; Gertsch and Ennik 1983; Lucas 1834) described their origin and evolution. The original range of *L. rufescens* was in the circum-Mediterranean region, but they have spread widely in many temperate and tropical areas including the islands of the Atlantic, Madagascar, the Hawaiian Islands, Australia, Mexico, and the United States (Gertsch and Ennik 1983) due to human agencies (Harvey 1996; Vetter 2008; Vetter and Barger 2002). *L. rufescens* itself originated in North Africa and has spread by human agencies over more than 5,000 years within the Mediterranean basin (Duncan *et al.* 2010; Planas and Ribera 2014). In India, *L. rufescens* has been recorded by Tikader (1963), Jose (2005), Sebastian and Peter (2009) and Solanki (2016); in Iran by Mirshamsi *et al.* (2013); in Thailand by Chomphuphuang *et al.* (2016). Today, *L. rufescens* has become globally spread by human activity; it rarely bites humans and the bites are not very harmful (Nentwig *et al.* 2017).

Here, we report finding a large population of *L. rufescens* near human habitations from the Kathiawar peninsula in Western India, where there was no published record, with details of biology, and distribution in Western India; and we propose how it may have arrived in Western India.

METHODOLOGY

A total of 51 spiders were collected by hand during an IQAC sponsored Spider Project Survey [MRP ref. No. IQAC/GJY/MRP/SEPT/2016/1646; Dt. September 30, 2016]. Among these, 30 male, 12 female, and 3 young spiders were caught during the months of September and October 2015, and January 2017 from Saurashtra University Campus (22.29° N, 70.74° E, 138 m msl, spread over 1,457 sq. km), Rajkot, Gujarat; and 3 adult male and 3 female spiders from Village Chalala (21.40° N, 71.16° E), Amreli, Gujarat. The collected spiders were brought to the laboratory, preserved in 70% alcohol and identified using Gertsch

and Ennik (1983), Greene *et al.* (2009), Lotz (2012), and Chomphuphuang *et al.* (2016). The female genitalia were dissected and cleared by keeping them for 5 minutes in 4% KOH aqueous solution.

Loxosceles rufescens, the only species of this genus reported from India, is closely related and similar to *L. fontainei*, *L. foutadjalloni*, *L. rufipes*, and *L. vonwredei*. It differs from *L. fontainei*, *L. foutadjalloni,* and *L. rufipes* in the palp tibia length/height ratio being less than 2.0; and from *L. vonwredei* in the palp tibia length/height ratio being less than 2.5 (Lotz 2012).

All the spider specimens were closely examined with a binocular stereo zoom microscope, along with a camera, to photograph the diagnostic features. All morphometric measurements (mm) were scaled under an ocular micrometer and TC Capture Software. Descriptions are based on one adult specimen for each sex and leg measurements of a single adult male and two adult female specimens (Table 1).

Abbreviations

AME = Anterior Median Eye; ALE = Anterior Lateral Eye; PLE = Posterior Lateral Eye; AME-ALE & AME-PLE = distance between; CL = Carapace Length; CW = Carapace Width (measured at the widest point); LA = Labium; SL = Sternum Length; SW = Sternum Width; TL = Total Length; SUBIOZ = Saurashtra University, Museum of Department of Biosciences, Zoology; W = West and E = East zone of Saurashtra University Campus; V = Visit.

All voucher specimens have been deposited at the Saurashtra University, Museum of Department of Biosciences, Zoology, Rajkot, Gujarat, India.

All the collected specimens were photographed in their natural macro and micro habitats, and their available food sources were noted.

The breeding biology and behaviour of *L. rufescens* were studied in the laboratory. Glass jars provisioned with a bed of dried twigs, with the bottom filled with black soil, were used to provide natural environs. The female was kept in the glass jar for three months, and male spider was also introduced for mating at the same time. The spider was fed daily with small ants, large ants, and small cockroaches. Duration of egg laying, incubation, hatching and number of spiderlings were recorded. Incidentally, we observed that in the laboratory reared specimens, some survived for a month without any food at all. Our observations support the resistance to starvation in genus *Loxosceles* noted by Vetter (2008).

Detailed information about the sight records of this species and its distribution in Gujarat State, Western India were gathered with their locality, macro and microhabitats, including GPS locations (Table 2).

Table 1: Legs and palp measurements (average of left and right side in mm) of one adult male and 2 females of *Loxosceles rufescens*

	I	II	III	IV	Palp
Male SUBIOZ82-WV27(6), Total body length: 6.90 mm					
Coxa	1.00	1.00	1.00	1.00	0.20
Trochanter	0.50	0.50	0.50	0.50	0.20
Femur	6.30	7.50	6.00	6.50	1.15
Patella	1.05	1.20	1.10	1.00	0.35
Tibia	7.00	8.70	5.65	6.50	0.95
Metatarsus	6.90	8.50	6.40	7.50	-
Tarsus	1.50	1.50	1.30	1.50	0.30
Bulb	-	-	-	-	0.60
Embolus	-	-	-	-	0.20
Total	**24.25**	**28.90**	**21.95**	**24.50**	**3.95**
Leg Formula of Male : 2413					
Female SUBIOZ82-WV29(1), Total body length = 8.0 mm					
Coxa	0.98	1.02	1.00	1.06	-
Trochanter	0.58	0.55	0.53	0.54	0.20
Femur	4.55	4.86	4.28	4.76	0.75
Patella	1.01	1.03	1.08	0.96	0.33
Tibia	4.81	5.10	3.94	4.73	0.74
Metatarsus	4.64	5.16	4.49	5.21	-
Tarsus	1.38	1.50	1.12	1.37	0.86
Bulb	-	-	-	-	-
Embolus	-	-	-	-	-
Total	**17.96**	**19.22**	**16.44**	**18.62**	**2.88**
Leg Formula of Female : 2413					
Female SUBIOZ64-EV20(11), Total body length = 6.5 mm					
Coxa	0.80	0.83	0.81	0.86	-
Trochanter	0.47	0.45	0.43	0.44	0.16
Femur	3.70	3.95	3.48	3.87	0.61
Patella	0.82	0.84	0.88	0.78	0.27
Tibia	3.91	4.14	3.20	3.84	0.60
Metatarsus	3.77	4.19	3.65	4.23	-
Tarsus	1.12	1.22	0.91	1.11	0.70
Bulb	-	-	-	-	-
Embolus	-	-	-	-	-
Total	**14.59**	**15.60**	**13.34**	**15.12**	**2.34**
Leg Formula of Female : 2413					

Measurements not taken: (-)

DESCRIPTION

Systematics

Family: Sicariidae Keyserling, 1880

Subfamily: Loxoscelinae

Genus: *Loxosceles* Heineken & Lowe, 1832

Synonymy: *Loxosceles* Heineken & Lowe, 1832 in Lowe, 1832: 321. For detailed synonymy: see Gertsch & Ennik (1983) and World Spider Catalog (2018, Version 19.0).

Type Species: *Scytodes rufescens* (Dufour, 1820).

Remarks: Except for the three young, all the collected specimens (male 33, female 15) of *Loxosceles* were examined for general diagnostic characters.

Diagnostic characters: Flattened carapace, longer than wide with a deep fovea (Figs 1 and 2), clypeus porrect with hairs, six eyes in three dyads in a recurved transverse row; female pedipalp without a claw; legs long and slender (Fig. 2a); sternum longer than wide (Figs 1d and 2c); abdomen oblong with spine-like setae. **Female** diagnostic character in *L. rufescens*: structure of the spermathecae (Duncan *et al.* 2009; Gertch and Ennik 1983; Lotz 2012, 2017) characterized by receptacles closely spaced; wide copulatory tubes with lateral brown sclerotized area (Fig. 2e & f). **Male** palps with a simple bulb that lacks a hematodocha and inward curved thin long embolus; male palp tibia length/height ratio is <2.0 (Fig. 1g, h) (Gertch and Ennik 1983; Lotz 2012, 2017).

Loxosceles rufescens (Dufour, 1820)

Scytodes rufescens: Dufour, 1820: 203, pl. 76, fig. 5. For detailed synonymy: see World Spider Catalog (2018).

Loxoscles rufescens: Simon, 1873: 38; Pavesi, 1876: 435; Simon, 1914: 75, fig. 127. Gertsch and Ennik, 1983: pp. 353–355, figs 341–343, 348–351; Map 13. For detailed synonymy: see World Spider Catalog (2018).

Material examined: SUBIOZ82-WV27(6) Single male, 18.ix.2015, and SUBIOZ82-WV29(1) single female, 1.x.2015, both West Zone of Saurashtra University Campus, Sanskrit Bhavan's Library Building, collected by Dal (Dal 2016); SUBIOZ-EV20 (11) One female, 25.ii.2017, East Zone of Saurashtra University, Art Gallery Building, collected by Nadiyapara (Nadiyapara, 2017), Rajkot, Gujarat.

Description of Male [SUBIOZ82-WV27(6), Table 1, Fig. 1a–h]

TL = 6.90 mm; Cephalothorax 2.7 mm long, 3.0 mm wide; abdomen length 3.40 mm, abdomen width 3.30 mm; morphometry of legs and palp given in Table 1; leg formula 2413.

Colours (live specimen): Carapace and chelicerae light brown, anterior carapace with dark brown 'violin' pattern (Fig. 1a); Palp pale yellow to orange, covered by short black setae, labium and maxilla brown. Eyes are reddish-brown; Long, slender, light brown legs except all femora with dark brown; Coxae yellowish brown, and sternum pale yellow with light brown margin, abdomen light to dark brown. Colours (preserved in alcohol): Cephalothorax and chelicerae reddish-brown, eyes yellow with black ring, labium and maxilla yellow to reddish-brown, sternum and legs pale yellow; abdomen dark brown, ventrum greyish on the middle and yellowish-grey laterally.

Cephalothorax: Slightly wider than long, narrow anteriorly, six eyes black at the base, in two slightly recurved rows. **Eyes**: Diameter of all eyes similar AME: ALE: PLE = 0.14 mm; distance between AME-ALE-0.24, AME-PLE-0.46, ALE-ALE-0.60, PLE-PLE-0.93. Clypeus reddish-brown, narrow bulbus elevated from carapace, porrect, with hairs and wider (1.2 mm) than long (height 0.5 mm); Chelicera 1.0 mm long, short (0.3 mm) fang folded with cheliceral teeth, promargin 2, retro-margin 1; Labium 0.5 mm long, 0.5 wide; Maxilla longer (height 0.9 mm) than wide (0.3 mm), anterior end narrow near the apex, scapulae present, broad base; Sternum 1.8 mm long, 1.7 mm wide, pale with distinct hairs; all leg segments clothed with trichobothria.

Pedipalp: Yellow, elongated, with moderately broad cymbium. Palpal tibial length/height ratio = (1.75) < 2.0; Cymbium (0.621) measures two-thirds of tibial length (0.950) and half of tarsal length. Cymbium (0.621) as long as palpal bulb (0.611), bulb globular and 3 times longer than embolus (Table 1), thin embolus dorsolateral slightly curved.

Abdomen: Light to dark brown, elongated, clothed with hairs. Anterior spinnerets 0.4 mm long, posterior spinnerets 0.3 mm long, ventrally colulus present.

Description of Female [SUBIOZ64-EV20(11), Table 1, Fig. 2a-f]

TL = 6.50 mm; Cephalothorax 2.61 mm long, 2.33 mm wide; abdomen 3.59 mm long, 2.26 mm wide; morphometry of legs and palp given in Table 2; leg formula 2413.

Colours (live specimen): Carapace, chelicerae, and legs yellowish brown, all femora light brown, unlike those of male; Abdomen oval, yellowish, covered with setae; distinctly larger than that of male. Palp pale yellow to orange covered by short black setae and without claw; eyes, coxae, sternum, labium and maxilla like those of male. Colours (preserved in alcohol): Carapace and chelicerae yellow to orange-brown. Overall body and coloration similar to that of male, except shape and colour of abdomen; abdomen globulous; light to dark brown cranio-caudally (Fig 2b); yellow to orange brown ventrally.

Cephalothorax: Slightly longer than wide; 0.98 mm smaller than abdomen, and smaller (2.61 mm) than that of male (2.7 mm).

Eyes, Palps and Abdomen: Diameter of all eyes similar AME: ALE: PLE = 0.14; distance between AME-ALE-0.14, AME-PLE-0.32, ALE-ALE-0.56, PLE-PLE-0.69 (all distances shorter than in male). Clypeus narrow to broad (0.82–1.20 mm) cranio-caudally; wider (1.2 mm) than long (0.62 mm), chelicerae smaller (0.49) than male (1.0 mm long), short fang (0.35 mm) folded, with cheliceral teeth

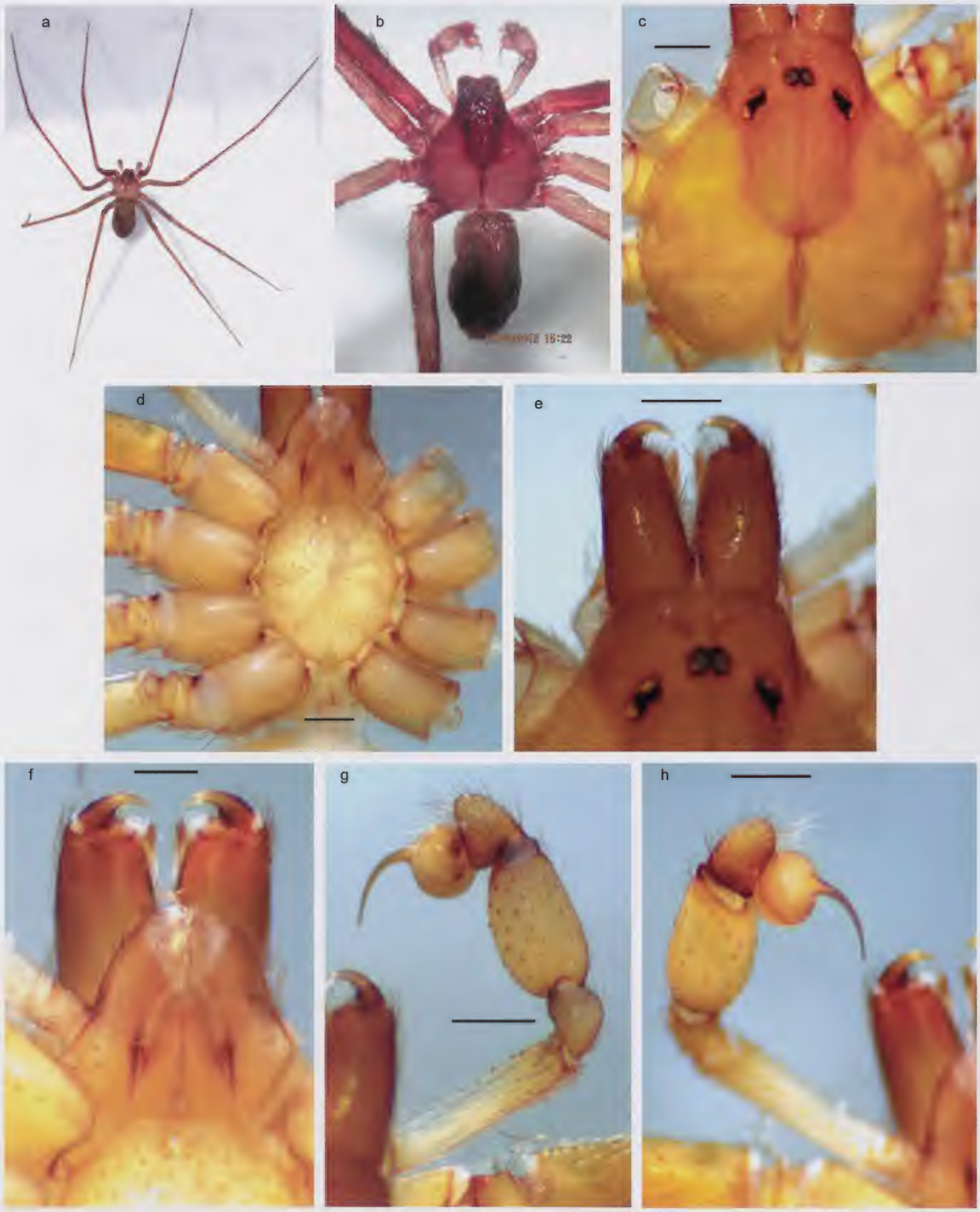

Fig. 1 (a–h): Diagnostic characters of *Loxosceles rufescens* [male, SUBIOZ-WV27 (6)]:
a. dorsal view; b. dorsal view in alcohol; c. carapace with violin marking & clypeus; d. sternum, coxa & trochanter; e. six eyes arranged in three dyads & chelicere with fangs; f. labium & maxillae; g. prolateral pedipalp; h. retrolateral pedipalp (scale bar = 0.5 mm)

Fig. 2(a–f): Diagnostic characters of *Loxosceles rufescens*: [female, SUBIOZ82--WV29(1) & SUBIOZ64-EV20(11)]
a. habitus dorsal view; b & c. dorsal & ventral view in alcohol; d. spinnerets and colulus; e. epigynum external view; f. spermatheca internal view (scale bar = 0.5 mm except b = 1 mm)

similar to male, labium triangular 0.57 mm long, 0.50 mm wide, maxillae with bristle smaller (0.81 long, 0.24 width) in female than in male (0.9 mm long, 0.3 mm width); Sternum 1.08 mm long, 0.89 mm wide, with distinct hairs, long, slender legs with trichobothria, all femora not as dark brown as male. Female palp without claw, abdomen slightly bigger (3.59 mm) than male (3.40 mm); Anterior spinnerets 0.55 mm long, posterior 0.51 mm long and colulus 0.23 mm long (Fig. 2d). External epigyne has one broad sclerotized gonopore (Fig. 2e); spermathecae characterized by presence of closely-spaced wide receptacles, laterally brown, sclerotized (Fig. 2e & f). In other female specimens colour varies from light brown to dark brown, seldom with greyish black abdomen.

HABITS, HABITAT, AND OCCURRENCE

L. rufescens specimens were collected near human habitations, namely, residency, art gallery, and educational buildings. All spiders (100%) were found from buildings and their microhabitats were corners of walls, boxes of stored books, electric meter box, unused wooden and steel cupboards and their crevices, which were covered with irregular web (Note: Photographic evidence provided – Eds), large cardboard sheet with debris of large and small ants entangled in the irregular web (Note: Photographic evidence provided – Eds), which the spider may have eaten. In the library of Sanskrit Bhavan, where most of the books were stored in unused wooden cupboards and boxes, a large population of *L. rufescens* was found typically in

Table 2: Distribution of *Loxosceles rufescens* in Gujarat State, Western India.

S. No.	Year	No. of specimens	Macro-habitat	Micro-habitat	Location	Coordinates	Reference
1.	2015	6♀, 6♂, 15♂SA,3♀J, 3♂J, 3Y	Library building of Sanskrit Bhavan	Library building wall, cardboard sheet, unused wooden/steel furniture	Saurashtra University Campus, Rajkot City	22°17′23.8″ N 70° 44′29.8″ E	Dal (2016)
2.	2016	1♀, 1♂	Jambughoda Wildlife Sanctuary	Leaf litter, crevices of mine wall	Bharuch, Amod and Jambusar talukas, Bharuch Borsad taluka, Kheda	22° 20″-20° 33″ N 73° 35″-73° 45″ E	Solanki (2016)
3.	2017	3♀, 3♂	Residential building	Behind steel cupboard	Village Chalala, Amreli	21° 24′10.3″ N 71° 09′42.1″ E	Press note by Trivedi and Dal (2017)
4.	2017	3♀, 6♂J	Art Gallery building	Electric wooden box, Wall corner	Saurashtra University Campus, Rajkot City	22°17′22.8″ N 70° 44′37.3″ E	Nadiyapara (2017)

Abbreviations: SA - Subadult, J - Juvenile, Y - Young

close association with Common Indian Black Ant and Common Indian Large Ant (Note: Photographic evidence provided – Eds).

As to the question of how they arrived in Saurashtra University Campus, Rajkot, we collected information from the Sanskrit Department, and presumed that they may possibly have been transported through donated and gifted books from United States and UK. Furthermore, the buildings were surrounded by many Pipal *Ficus religiosa* trees and an entire ant colony extended from a tree to the library wall. Close association with the ant colony may have helped to establish the spider population in the Library. Since 2000, we carried out studies on spiders of Saurashtra University Campus, yet not a single specimen of *L. rufescens* was found till the specimens in this study were collected in 2014 by the first author.

Behaviour: Study in captivity (Table 3)

The breeding data for three months, beginning with the first egg laying incident and successive events till the emergence of spiderlings were systematically observed and noted (Table 3). Three egg sacs were laid during the

Table 3: Observations on behaviour in captivity.

Date on which *L. rufescens* was kept in captivity	Date of egg-laying and observations on egg-sacs	No. of days required for incubation	No. of egg-sacs survival and incubation	Status of egg-sacs, colour and no. of spiderlings	Food -provided
25/2/2017	19/3/2017	22	1st egg-sac laid	Live, creamish white	Small & large ants
	24/3/2017	05	1st egg-sac	Live, creamish white	Small & large ants
	27/3/2017	03	1st egg-sac	Became dried	Small & large ants
	7/4/2017	10	2nd egg-sac laid	Live, creamish white	Small & large ants
	16/4/2017	08	2nd egg-sac	Live, creamish white	Small & large ants
	28/4/2017	11	2nd egg-sac	Became dried	Small & large ants
	3/5/2017	05	3rd egg-sac	Live, creamish white	Small cockroaches
	17/5/2017	14	3rd egg-sac	Live, creamish white	Small cockroaches
	31/5/2017	28	3rd egg-sac	11 hatchlings	Small cockroaches

experimental period, requiring 19 to 25 days for successive laying of egg sacs and approximately 25 days was required for successful hatching, with 11 spiderlings from a single egg sac. After hatching, the spiderlings were released safely in their natural habitat. Here, the success of the 3rd egg-mass was possibly due to change in the food offered, small cockroaches instead of ants. The higher nutritional value of cockroaches may have ensured greater success in spider emergence. The spiders were not very active, preferring to hide under soil and the bark of logs.

Geographic distribution in Western India

Detailed information about the records of this species in Gujarat State, Western India is shown in Table 2. Solanki (2016) reported *L. rufescens* from Bharuch and Kheda districts. Over a two-year study (2016–2017) around Saurashtra University Campus, Rajkot, several specimens were collected by Dal (2016) and Nadiyapara (2017). Six individuals of *L. rufescens* were also spotted in Chalala village in Amreli district. Considering the distribution pattern recorded in Table 2, it is clear that *L. rufescens* occurs in very few districts in Gujarat. We conclude that the status of the species is rare in Rajkot, Bharuch, Kheda, and Amreli districts of Gujarat State, Western India.

Medical Importance, Loxoscelism, Case study and Public awareness

Many publications have described the identification and purification of the venom content in the *Loxosceles* in North, Middle, and South America (Barbaro *et al*. 2005; Cunha *et al*. 2003; Da Silva *et al*. 2004). *L. rufescens* is reported to have far less dangerous venom than *L. laeta, L. reclusa*, and some other species (Gertsch and Ennik 1983). In Florida, the only verified case determined to be a public health threat was reported by Edwards (2001). A case study reported by Yigit *et al*. (2008) was treated by skin grafting in Turkey. Nentwig *et al*. (2017) examined the literature on *L. rufescens* bites to humans and concluded that these are rare and not as harmful as often described.

DISCUSSION

The Circum-Mediterranean Recluse spider in Western India can be characterized as widely distributed but rarely encountered. In the specimens recorded from three localities in the Rajkot and Amreli survey, 96% (51/53) were from residential buildings near human habitations (see Table 2) and 4% (2/53) from leaf litter and crevices of mine walls (Solanki 2016). *L. rufescens* shows a markedly troglophilic tendency (USFWS 2004; Chomphuphuang *et al* 2016).

Our future plan is to survey the species' distribution in urban ecosystems, to check the impact of global transportation on its range extension near human habitations and in other such semi-arid areas of Kathiawar.

ACKNOWLEDGEMENTS

We are thankful to Dr Ken Cramer, Dept of Biology, Monmouth College, Monmouth, IL and Dr PA Sebastian, Division of Arachnology, Sacred Heart College, Kochi for providing useful taxonomic literature. We thank M.Sc. students Jagruti Nadiyapara, Sumita Vaghera, research scholar Hitesh Parmar and Yogesh Khandla for their assistance in the field collection; Mr Iqbal Dal, naturalist and wildlife photographer, for the photographs of the male spider and help in findings from Chalala village, Amreli. We acknowledge the Internal Quality Assurance Cell/Golden Jubilee Year/Major Research Project (IQAC/GJY/MRP) sponsored Spider Project, Saurashtra University, Rajkot, India, for funding support.

REFERENCES

Barbaro, K.C., I. Knysak, R. Martins, C. Hogan & K. Winkel (2005): Enzymatic characterization, antigenic cross-reactivity and neutralization of dermonecrotic activity of five *Loxosceles* spider venoms of medical importance in the Americas. *Toxicon* 45: 489–499.

Cameron, H.D. (2005): An etymological dictionary of North American spider genus names. *In*: Ubick, D., P. Paquin, P.E. Cushing, & V. Roth (Eds): Spiders of North America: an identification manual. American Arachnological Society, Keene (New Hampshire). S. 274–330.

Chomphuphuang, N., S. Deowanish, C. Songsangchote, V. Sivayyapram, P. Thongprem, & N. Warrit (2016): The Mediterranean recluse spider *Loxosceles rufescens* (Dufour, 1820) (Araneae: Sicariidae) established in a natural cave in Thailand. *Journal of Arachnology 44*: 142–147.

Cunha, R.B., K.C. Barbaro, D. Muramatsu, F.C.V. Portaro, W. Fontes & M.V. De Sousa (2003): Purification and characterization of loxnecrogin, a dermonecrotic toxin from *Loxosceles gaucho* brown spider venom. *Journal of Protein Chemistry 22*: 135–146.

Da Silva, P.H., R.B. Da Silveira, M.H. Appel, O.C. Mangili, W. Gremski & S.S. Veiga (2004): Brown spiders and loxoscelism. *Toxicon 44*: 693–709.

Dal, P. (2016): Systematics and diversity of Spiders (Araneae) of Saurashtra University Campus, Rajkot, India. M.Sc. Thesis, Saurashtra University, Rajkot, Gujarat, India, 1–69.

Dufour, L. (1820): Description de cinq arachnides nouvelles. *Annales générales des sciences physiques, 5*: 198–209.

Duncan, R., M. Rynerson, C. Rebera & G. Binford (2010): Diversity of *Loxosceles* spiders in Northwestern Africa and molecular support for cryptic species in the *Loxosceles rufescens* lineage. *Journal of Molecular Phylogenetics and Evolution 55*: 234–248.

Edwards, G.B. (2001): The present status and a review of the brown

recluse and related spiders, *Loxosceles* spp. (Araneae: Sicariidae), in Florida. *Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Entomology Circular. 406*: 1–6.

Gertsch, W.J. (1958): The spider genus *Loxosceles* in North America, Central America, and the West Indies. *American Museum Novitates 1907*: 1–46.

Gertsch, W.J. (1967): The spider genus *Loxosceles* in South America (Araneae, Scytodidae). *Bulletin of the American Museum of Natural History 136*: 117–174.

Gertsch, W.J. & F. Ennik (1983): The spider genus *Loxosceles* in North America, Central America and the West Indies (Araneae: Loxoscelidae). *Bulletin of the American Museum of Natural History 175*: 264–360.

Greene, A., M.L. Breisch, T. Boardman, B.B. Pagac Jr, E. Kunickis, R.K. Howes & P.V. Brown (2009). The Mediterranean recluse spider, *Loxosceles rufescens* (Dufour), an abundant but cryptic inhabitant of deep infrastructure in the Washington, DC Area (Arachnida: Araneae: Sicariidae). A*merican Entomologist 55(3)*: 158–169.

Harvey, M.S. (1996): The first record of the Fiddle-back spider *Loxosceles rufescens* (Araneae: Sicariidae) from Western Australia. *Rec. West. Austral. Mus. 18*: 223–224.

Heinecken, C. & R.T. Lowe (1832): Description of two species of Araneidae, natives of Madeira. *Zool. Jour. 5*: 320–322.

Jose, S.K. (2005): Occurrence of *Loxosceles rufescens* (Dufour 1820) in Lakshadweep Island, India (Araneae: Sicarridae). National Conference on Animal Taxonomy. Pp. 1–2.

Lotz, L.N. (2012): Present status of Sicariidae (Arachnida: Araneae) in the Afrotropical region. *Zootaxa 3522*: 1–41.

Lotz, L.N. (2017): An update on the spider genus *Loxosceles* (Araneae: Sicariidae) in the Afrotropical region, with description of seven new species. *Zootaxa 4341(4)*: 475–494.

Lucas, H. (1834): Description de *Scytodes rufipes*. *Magasin de zoologie, de Guérin-Méneville 4(8)*: 1–6.

Mirshamsi, O., M. Hatami & A. Zamani (2013): New records of the Mediterranean recluse spider *Loxosceles rufescens* (Dufour 1820) and its bite from Khorasan Province, Northeast of Iran (Araneae: Sicariidae). Iran. *J. Anim. Biosyst. 9*: 83–86.

Nadiyapara, J. (2017): Systematics and Diversity of Spiders (Araneae) of Saurashtra University Campus, Rajkot. M. Sc. Thesis, Saurashtra University, Rajkot, Gujarat, India. Pp. 1–69.

Nentwig, W., P. Pantini, & R. Vetter (2017): Distribution and medical aspects of *Loxosceles rufescens*, one of the most invasive spiders of the world (Araneae: Sicariidae). *Toxicon 132*: 19–28.

Planas, E. & C. Ribera (2014): Uncovering overlooked island diversity: colonization and diversification of the medically important spider genus *Loxosceles* (Arachnida: Sicariidae) on the Canary Islands. *Journal of Biogeography 41*: 1255–1266.

Sebastian, P.A. & K.V. Peter (2009): Spiders of India. University Press, Hyderabad, India. Pp. 614.

Solanki, R. (2016): Ecology and diversity of spider fauna in southern tropical dry deciduous forests of Gujarat. Ph.D. Thesis, M.S. University, Baroda, Gujarat, India. Pp. 305.

Swanson, D.S. & R.S. Vetter (2006): Loxoscelism. *Clinics in Dermatology 24*: 213–221.

Tikader, B.K. (1963): On a new species of spider of the genus *Loxosceles* (Family Scytodidae) from India. *Proceedings of the Zoological Society, Calcutta 16*: 23–25.

USFWS (U.S. Fish and Wildlife Service) (2004): Draft Recovery plan for the Kauai cave arthropods: the Kauai cave wolf spider (*Adelocosa anops*) and the Kauai cave amphipod (*Spelaeorchestia koloana*). USFWS, Portland, Oregon. Pp. 57.

Vetter, R.S. (2008): Spiders of the genus *Loxosceles* (Araneae: Sicariidae): a review of biological, medical and psychological aspects regarding envenomation. *Journal of Arachnology 36*: 150–163.

Vetter, R.S. & D.K. Barger (2002): An infestation of 2,055 brown recluse spiders (Araneae: Sicariidae) and no envenomations in a Kansas home: Implications for bite diagnoses in non endemic Areas. *Journal of Medical Entomology 39(6)*: 948–951.

World Spider Catalog (2018): Natural History Museum Bern, online at http://wsc.nmbe.ch, version 19.0. Accessed on February 23, 2018.

Yigit, N., A. Bayram, D. Ulasoglu, T. Danisman, O.I. Corak & Z. Sancak (2008): *Loxosceles* spider bite in Turkey (*Loxosceles rufescens*, Sicariidae, Araneae). *Journal of Venomous Animals and Toxins including Tropical Diseases 14(1)*: 178–187.

Recommended Citation

Trivedi, Varsha & Parin Dal (2019): Occurrence, distribution and description of *Loxosceles rufescens* (Dufour, 1820) (Araneae: Sicariidae) from Western India. *J. Bombay Nat. Hist. Soc. 116*: 3–10. doi: 10.17087/jbnhs/2019/v116/123017

AMPHIBIAN DIVERSITY IN TWO DIFFERENT LANDSCAPES OF KONKAN REGION, NORTHERN WESTERN GHATS, INDIA[1]

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[1]Accepted March 12, 2019
First published: July 4, 2019 | doi: 10.17087/jbnhs/2019/v116/115359
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We present the results of our amphibian species inventory surveys conducted in Konkan region, Maharashtra. In a three-month study period, a total of 18 species of amphibians (17 anurans and one caecilian) belonging to 13 genera and seven families were recorded. Habitats including lateritic plateaus and forest areas were studied for amphibian diversity and population density. Forest habitat supported the maximum species occurrence, whereas the density of amphibians per unit area was found to be the maximum on plateaus. Rare and endemic species were highly influenced by habitat variables like canopy cover, mode of tadpole development, habitat specificity, stream persistence, humidity, threat status, and endemism. Occurrence of endemic and threatened species like *Pseudophilautus amboli*, *Uperodon mormorata*, and records of a lesser known caecilian like *Gegeneophis seshachari* show the importance of this area for conservation prioritization. Anthropogenic threats listed during the study are also discussed. This baseline data will serve as an asset for further monitoring and determining action plans for amphibian conservation in the Konkan region.

Key words: Endemic, threatened, amphibians, coastal plateau, Western Ghats, Maharashtra, India

INTRODUCTION

The Western Ghats of India are a mountain range designated as one of the 35 biodiversity hotspots of the world (Mittermeier *et al.* 2011); they were recently declared as a World Heritage Site by UNESCO (http://whc.unesco.org/en/list/1342). The Western Ghats harbour a rich diversity of endemic amphibians. Around 236 amphibian species are known, of which 215 (over 92%) are endemic to this zoogeographic region (Frost 2018). Recent descriptions of novel genera (Dahanukar *et al.* 2016; Oliver *et al.* 2015) and a flurry of new species descriptions in the last decade (Biju and Bossuyt 2009; Biju *et al.* 2014; Vijayakumar *et al.* 2014; Padhye *et al.* 2013, 2014, 2015; Modak *et al.* 2015; Dinesh *et al.* 2015; Dahanukar *et al.* 2016; Garg *et al.* 2017) indicate that the Western Ghats are subject to a high level of endemic amphibian radiation. More than 61% of endemic amphibians known from this region are still under the category of Data Deficient (DD) or Not Evaluated (NE) due to lack of information on the population status, distribution, and possible threats to the species (IUCN 2018).

Limited data on range of occurrence, population structure, and possible threats are major impediments in assessing the Red List and conservation status of species. Baseline data on amphibian diversity and population structure is still unknown from several parts of the northern Western Ghats, which are only now getting some attention because of the descriptions of new species from this region (Biju *et al.* 2014; Dinesh *et al.* 2015; Garg and Biju 2017; Modak *et al.* 2015; Padhye *et al.* 2013, 2014, 2015, 2017). Lack of data is a major reason for relatively few conservation initiatives in the Konkan region, a coastal plain which lies at the foothills on the western side of the northern Western Ghats of Maharashtra. Most of the landscapes in the coastal plains of Konkan region are composed of geologically younger laterite capped plateaus (Ollier and Sheth 2008), with patches of moist deciduous forest on the slopes.

In this study, we provide a comprehensive account of the existing amphibian diversity of the Konkan region. We have studied amphibian species diversity across lateritic plateaus and forested areas of Ratnagiri and Sindhudurg districts. Taxonomic features for species identification have been discussed in detail for *Uperodon mormorata* and *Gegeneophis seshachari*.

MATERIAL AND METHODS

Study site

The study was conducted on the lateritic coastal plateaus of Ratnagiri and Sindhudurg districts of Maharashtra, India (Fig. 1). The area receives 3,000 to 5,000 mm annual rainfall from the southwest monsoon. The wet period in Konkan is confined to four months, starting from June and ending in September. More than 60% of the study area is covered by

lateritic coastal plateaus; some are adjacent to the Arabian Sea (Fig. 2). Plateau areas, namely Janshi (16.586° N; 73.392° E), Ambolgad (16.644° N; 73.324° E), Girye-1 (16.511° N; 73.333° E), Girye-2 (16.527° N; 73.320° E), Dhaulvalli-1 (16.608° N; 73.407° E), Tiware-1 (16.668° N; 73.340° E), Jaitapur (16.597° N; 73.325° E), and Ansure (16.573° N; 73.412° E), and forest sites Tiware-2 (16.680° N; 73.337° E), Rajwadi (16.677 °N; 73.360° E), Dhaulvalli-2 (16.620° N; 73.423° E), Rameshwar (16.533° N; 73.317° E), Kasheli (16.665° N; 73.381° E), and Anantwadi (16.639° N; 73.405° E) were surveyed systematically for amphibian diversity and density estimation. Vegetation on the plateau slopes is primarily moist deciduous forest (Fig. 3). Certain patches of forest on the plateaus were observed to be replaced with mango and cashew plantations; such areas were also searched for amphibians. Field surveys were conducted in the months of June to August 2012.

Data Collection

The methodologies adopted for amphibian sampling and data analysis follow Gururaja and Ramachandra (2012). The study area was first graticulated uniformly into 1 sq. km grids. Fourteen sampling localities (Fig. 1) were selected randomly, using the stratified random sampling method. Among the 14 sampling localities, eight sites represent lateritic plateau habitat, while six represent forest habitat. Study sites were surveyed for amphibian diversity using quadrate sampling method. At each study site, a single quadrate with an area of 100 sq. m was laid and sampled for species diversity. Species data was collected for a total of 14 such quadrates. Each quadrate was searched during a time constraint of 30-minute duration in the evening to early night period (18:00–22:00 hrs). Quadrates were laid in such a way that they would cover all possible amphibian breeding habitats. To avoid redundancy in sampling, we collected all the amphibian specimens found in a quadrate in a wet cotton bag. The number of species and the abundance of each species were recorded, and all individuals were released back into the same area.

At each site, habitats such as forest floor litter, underside of rocks and boulders, tree bark and leaves, water pools, and rocky crevices near flowing streams were carefully searched for amphibians. Most specimens were identified in the field using an available field guide (Gururaja 2012). In case of unidentified species, a few representative specimens were collected, fixed in 4% formaldehyde and stored in 70% ethanol. IUCN guidelines were referred for scientific collection of threatened amphibian species (IUCN 2016). The voucher specimens have been deposited in the collection of Bombay Natural History Society (BNHS). We conducted this study under the grant permit of Coastal Biodiversity Assessment Project.

Species identification was further confirmed by examining voucher specimens and field photographs, following standard taxonomic literature (Annandale 1919; Boulenger 1890; Biju and Bossuyt 2009; Biju *et al.* 2011; Bossuyt and Dubois 2001;

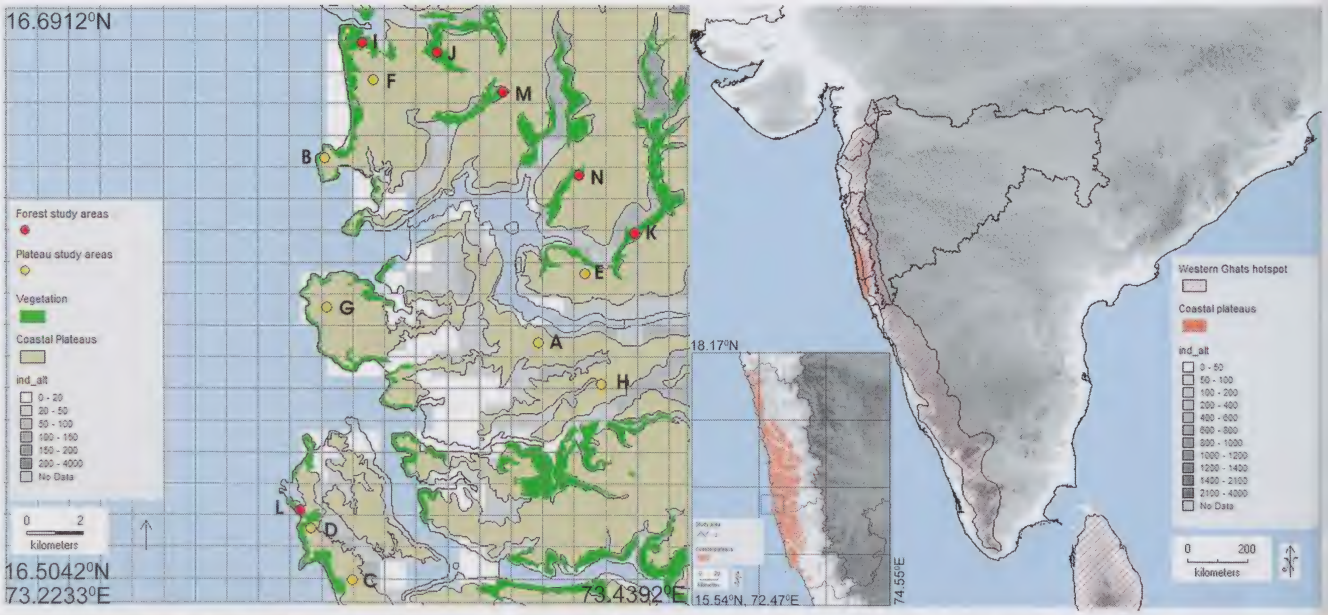

Fig. 1: Sampling locations: (A) Janshi; (B) Ambolgad; (C) Girye-1; (D) Girye-2; (E) Dhaulvalli-1; (F) Tiware-1; (G) Jaitapur; (H) Ansure; (I) Tiware-2; (J) Rajwadi; (K) Dhaulvalli-2; (L) Rameshwar; (M) Kasheli; (N) Anantwadi

Daniel 1963 a, b; Daniel 1975; Daniel and Sekar 1989; Dinesh *et al.* 2015; Garg and Biju 2017; Gower *et al.* 2007; Padhye *et al.* 2013, 2014, 2015, 2017). Threat status of the species was obtained from IUCN Red List of Threatened Species (IUCN 2018). Current taxonomic status mainly follows Frost (2018).

Data Analysis

Irrespective of taxonomic position, we classified the species into ecologically similar groups; this method has been used to understand the complex pattern of species assemblage, richness and community structure (Gururaja and Ramachandra 2012; Katwate *et al.* 2013). We used relative percentage humidity, stream persistence, land use pattern, and canopy cover as habitat variables. Endemism, threat status, habitat specificity, and tadpole habitat (mode of reproduction) were used as ecological variables for data analysis (Table 1). All the variables were graded from lowest (1) to highest (10) category, and details of the habitat and ecological guild classification are given in Table 1. Temperature and relative percentage humidity were recorded using digital hygro-thermometer. Canopy coverage was estimated with a spherical densitometer.

The actual number of individuals encountered during quadrate sampling was used for calculating alpha and beta diversity indices. Shannon index of diversity was calculated using the equation: $H' = -\sum p_i (\ln p_i)$, where $p_i = n_i/N$ and n_i is the number of individuals of ith species and $N = \sum n_i$. We calculate the evenness index using the equation: $E = H'/\ln S$, where S is the number of species. Dendrogram representing species composition similarity across the study area was prepared using Bray-Curtis distances. Reliability of clustering was checked by bootstrapping for 1,000 iterations. We determined the relationship between environmental variables and species data through Canonical Correspondence Analysis (CCA). As a direct ordination method, CCA uses correlation and regression between species and environmental data. Based on weighted averaging and ordination of reciprocal averaging of species and environmental data CCA extracts the different axis scores for species, study sites, and variables. We selected first two axis scores representing maximum variation in data for ordination plot. All statistical analysis was performed in PAST ver1.98 (Hammer *et al.* 2001).

Table 1: Habitat and ecological variables guild gradation for amphibians recorded in study area

Variables	Range	Grade
Habitat variables		
Stream persistence	Seasonal	1
	Perennial	2
Land use	Mining/ quarrying	1
	Agriculture	2
	Mango/ cashew plantation	3
	Water bodies	4
	Plateau	5
	Forest	6
Canopy cover	Open	1
	Partial	2
	Closed	3
Humidity	0–70%	1
	>70–90%	2
	>90–100%	3
Ecological variables		
Endemism	Widely distributed throughout South Asia	1
	Widely distributed across India	2
	Endemic to Western Ghats and Sri Lanka hotspot	3
	Endemic to Western Ghats	4
Threat status	Data Deficient	1
	Least Concern	2
	Near Threatened	3
	Vulnerable	4
	Endangered	5
	Critically Endangered	6
Habitat specificity	Aquatic	1
	Semi aquatic	2
	Terrestrial	3
	Fossorial	4
	Arboreal	5
Tadpole	Aquatic	1
	Semi aquatic	2
	Arboreal/Direct development	3

*Note: Grade 1: lowest – 6: highest

RESULTS

From 14 quadrates sampled, we recorded a total of 291 individuals belonging to 18 species, including 17 anurans and one caecilian species (Table 2). The 18 species recorded belong to 13 genera and seven families. Family Dicroglossidae was found to be more species-rich, accounting for about 44% (eight species) of the total anuran species recorded. Families Rhacophoridae and Microhylidae had three species each.

Species recorded during the study were broadly classified in two major habitats: plateau and forest (Figs 2 and 3). A total of 13 amphibian species were recorded from plateaus, of which four species are endemic to the Western Ghats (Fig. 4). Unlike plateaus, forest habitat was found to be more species rich, with 17 species recorded. We found the maximum number of endemic species in forest habitat; out of

Table 2: Amphibian species abundance recorded at different sampling localities

Family/species[a]	Anuran abundance at different study localities[b]														IUCN
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Status[c]
Bufonidae															
Duttaphrynus melanostictus (Schneider 1799)	-	1	-	-	4	2	-	-	-	4	5	9	-	-	LC
Dicroglossidae															
Euphlyctis cyanophlyctis (Schneider, 1799)	3	6	-	11	7	3	-	2	-	-	-	-	-	3	LC
*Minervarya caperata** (Kuramoto, Joshy, Kurabayashi & Sumida, 2008)	1	2	-	6	1	1	2	-	-	-	-	1	-	2	NE
*Minervarya gomantaki** (Dinesh, Vijayakumar, Channakeshavamurthy, Torsekar, Kulkarni & Shanker, 2015)	6	9	1	13	8	12	11	1	-	-	-	-	-	5	NE
*Minervarya cepfi** (Garg & Biju, 2017)	3	-	2	-	6	8	1	1	-	-	-	-	-	1	NE
Minervarya syhadrensis (Annandale, 1919)	-	1	-	2	-	-	-	-	-	-	-	-	-	1	LC
Hoplobatrachus tigerinus (Daudin, 1802)	2	4	-	3	2	2	-	2	-	-	-	1	-	2	LC
Sphaerotheca pashchima Padhye, Dahanukar, Sulakhe, Dandekar, Limaye & Jamdade, 2017	-	-	-	-	1	-	-	-	2	3	5	-	1	-	NE
Sphaerotheca dobsonii (Boulenger, 1882)	-	-	-	-	-	1	-	1	1	1	2	2	2	-	LC
Microhylidae															
Microhyla nilphamariensis Howlader, Nair, Gopalan & Merilä, 2015	1	3	-	-	5	2	-	-	-	-	2	-	-	1	NE
*Uperodon mormorata** (Rao, 1937)	-	-	-	-	-	-	-	-	-	1	2	-	1	-	EN
Uperodon globulosus (Günther, 1864)	-	-	-	-	-	-	-	-	2	-	3	-	2	-	LC
Ranidae															
Hydrophylax bahuvistara Padhye, Jadhav, Modak, Nameer, & Dahanukar, 2015	-	-	1	-	-	-	-	-	-	2	1	-	1	-	NE
Ranixalidae															
*Indirana chiravasi** Padhye, Modak & Dahanukar, 2014	-	-	-	-	-	-	-	-	1	-	-	-	1	-	NE
Rhacophoridae															
Polypedates maculatus (Gray, 1830)	-	7	-	-	5	-	-	-	-	3	1	-	-	2	LC
*Pseudophilautus amboli** (Biju & Bossuyt, 2009)	-	-	-	-	-	-	-	-	4	3	1	-	2	-	CR
*Raorchestes bombayensis** (Annandale, 1919)	-	-	-	-	-	-	-	-	-	-	-	-	8	-	VU
Caeciliidae															
*Gegeneophis seshachari** Ravichandran, Gower & Wilkinson, 2003	-	5	3	-	-	7	-	-	-	-	-	-	-	-	DD
Total number of individuals/ 100 sq. m	16	38	7	35	39	38	14	7	10	17	22	13	18	17	

*Species endemic to the Western Ghats

[a] Current taxonomic status follows Frost (2018)

[b] Study sites: A, Janshi; B, Ambolgad; C, Girye-1; D, Girye-2; E, Dhaulvalli-1; F, Tiware-1; G, Jaitapur; H, Ansure; I, Tiware-2; J, Rajwadi; K, Dhaulvalli-2; L, Rameshwar; M, Kasheli; N, Anantwadi

[c]Conservation Status obtained from IUCN (2018), NE - Not Evaluated, LC - Least Concern, DD - Data Deficient, VU - Vulnerable, EN - Endangered, CR - Critically Endangered

Fig. 2: Available habitats on coastal plateaus. (a) rocky outcrop at site Jaitapur; (b) westward projected plateau at Ambolgad shows steep slopes, adjacent to Arabian sea; (c) temporary water puddles formed by early showers of monsoon at Dhaulvalli-1; (d) relatively deep water pool habitat at site Ansure; (e) and (f) General habitat of *Gegeneophis seshachari* at site Girye-1 and Tiware-1, from where small populations have been recorded under loose boulders

17 species recorded seven are endemic to the Western Ghats. We found three globally threatened anuran species in the study area (Table 2), namely *Pseudophilautus amboli* (CR), *Uperodon mormorata* (EN) and *Raorchestes bombayensis* (VU), and five recently described species, namely *Minervarya gomantaki*, *M. cepfi*, *Sphaerotheca pashchima*, *Hydrophylax bahuvistara*, and *Indirana chiravasi*, which are yet to be evaluated to assess their conservation status.

Amphibian species abundance recorded at all study sites is provided in Table 2. Species listed in threatened categories in IUCN Red List were found to be present in low abundance (Fig. 5). The newly described species *Minervarya gomantaki* was found to be the most abundant anuran species and mostly confined to lateritic plateau habitat. Species listed in Least Concern (LC) category, like *Euphlyctis cyanophlyctis* and *Duttaphrynus melanostictus*, ranked second and third

Fig. 3: General lowland forest habitats: (a) comparatively good canopy coverage at site Kasheli; (b) understorey forest vegetation at site Rajwadi; (c) small isolated forest patches along the edge of plateaus at site Tiware-2

abundant species respectively (Fig. 5). Species having low frequency of occurrence were generally found to be less abundant throughout the study period (Fig. 5). Western Ghats endemic species like *Uperodon mormorata* and *Indirana chiravasi* were found in very low abundance, occurrence rate of these species was also found to be very low (Fig. 5).

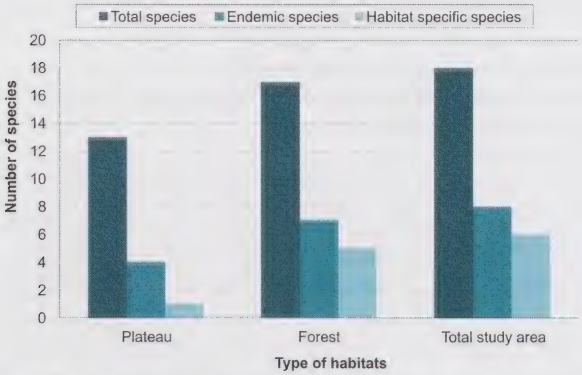

Fig. 4: Distribution pattern of amphibian species across the major habitats surveyed in study area

Fairly good populations of *Pseudophilautus amboli* were recorded at study sites Tiware-2, Rajwadi, Dhaulvalli-2 and Kasheli. A small population of Vulnerable (VU) species *Raorchestes bombayensis* was recorded from understorey vegetation at the study site Kasheli. Populations of lesser known *Gegeneophis seshachari* were found on the plateaus like Ambolgad, Girye-1, and Tiware-1.

Details of alpha diversity measures calculated across all the study sites are provided in Table 3. Plateaus at Ambolgad, Dhaulvalli-1, and Tiware-1, and forest area at Dhaulvalli-2 were found to be more species rich, with nine species at each site. Fewer species were found on plateaus like Girye-1 and Jaitapur, these two sites collectively hosted only four amphibian species. Despite very low species richness, all species recorded at Girye-1 and Jaitapur plateaus are endemic to the Western Ghats. Across the forest habitats, lower number of species were found at Rameshwar, which recorded only four anuran species. Similar pattern has been found in Shannon H' diversity estimates. Study sites like Ambolgad, Dhaulvalli-1, and Dhaulvalli-2 had higher H' index value (Table 3). Despite having maximum species

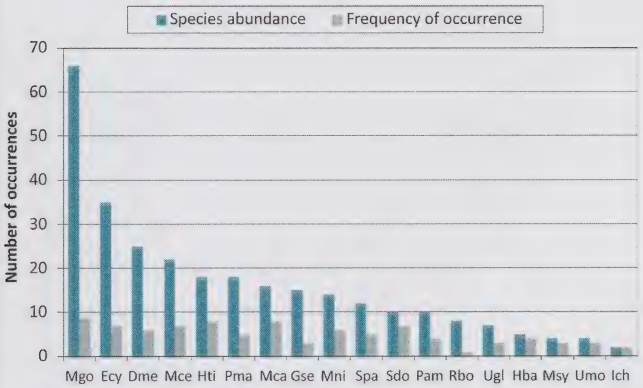

Fig. 5: Abundance and frequency of occurrence recorded for amphibian species.
Abbreviations: Species codes: Dme - *Duttaphrynus melanostictus*; Ecy - *Euphlyctis cyanophlyctis*; Mca - *Minervarya caperata*; Mce - *Minervarya cepfi*, Msy - *Minervarya syhadrensis*, Hti - *Hoplobatrachus tigerinus*; Mgo - *Minervarya gomantaki*; Spa - *Sphaerotheca pashchima*; Sdo - *Sphaerotheca dobsonii*; Mni - *Microhyla nilphamariensis*; Umo - *Uperodon mormorata*; Ugl - *Uperodon globulosus*; Hba - *Hydrophylax bahuvistara*; Ich - *Indirana chiravasi*; Pma - *Polypedates maculatus*; Pam - *Pseudophilautus amboli*; Rbo - *Raorchestes bombayensis*; Gse - *Gegeneophis seshachari*

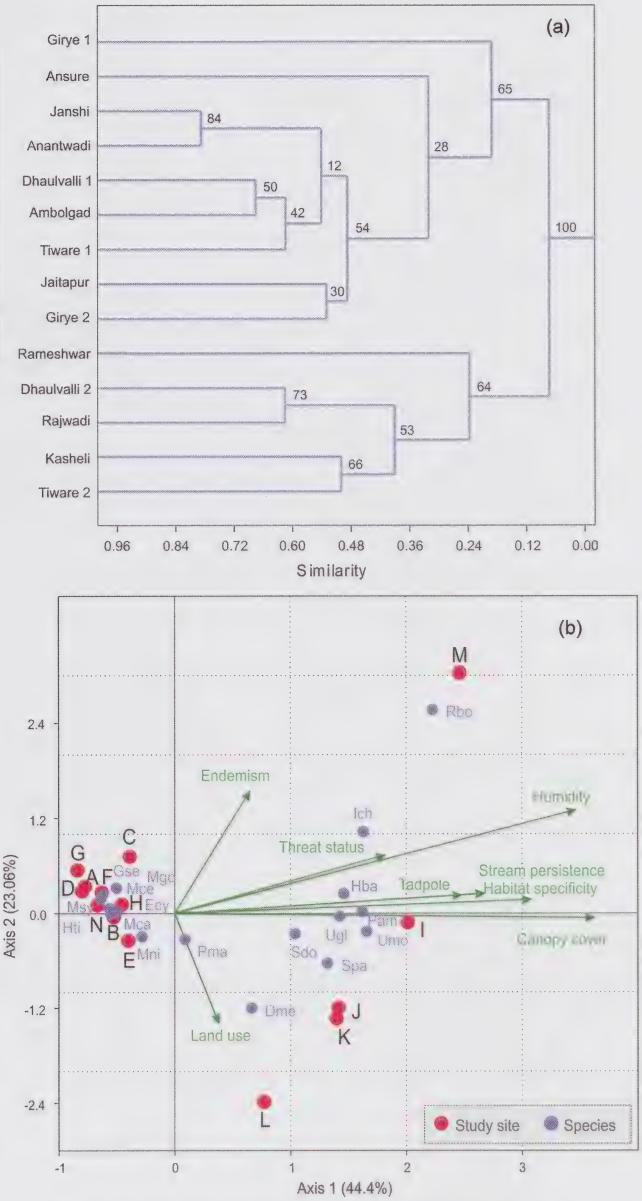

Fig. 6: (a) Dendrogram shows species assemblage structure similarity between different study localities calculated based on Bray-Curtis similarity index analysis of quadrate data;
(b) Canonical Correspondence Analysis (CCA) ordination triplot represents amphibian species distribution with respect to study sites and ecological variables.
Values in parentheses are percentage variation explained by each canonical axis. Study site labels are abbreviated as per Fig. 1. Species codes are abbreviated as per Fig. 5

richness, Tiware-1 had slightly lower H' index. Study sites like Jaitapur and Rameshwar had low Shannon and evenness indices. Density estimation of amphibians per 100 sq. m across the study area (Table 3) showed maximum abundance of individuals on the plateaus. Tiware-1 plateau and Kasheli forest area had the maximum number of endemic species.

Dendrogram representing the species composition similarity among the study area showed two different clusters (Fig. 6a). Forest areas like Rameshwar, Dhaulvalli-2, Rajwadi, Kasheli, and Tiware-2, except Anantwadi, formed a single cluster with less similarity within the clade, whereas plateaus like Girye-1, Ansure, Janshi, Dhaulvalli-1, Ambolgad, Tiware-1, Jaitapur, and Girye-2 formed a second cluster with maximum similarity among the clade. Anantwadi forest site was found to be in the second clade, probably because of maximum shared similarity in species composition with plateau areas.

Canonical Correspondence Analysis (CCA) explaining the species distribution patterns and their correlation with environmental variables predicted three different niche clusters (Fig. 6b). Species including *Minervarya gomantaki*, *M. syhadrensis*, *M. caperata*, *M. cepfi*, *Gegeneophis seshachari*, *Euphlyctis cyanophlyctis*, *Hoplobatrachus tigerinus*, and *Microhyla nilphamariensis* shared similar niches and formed a unique cluster on the first axis of the ordination plot. Species involving *Polypedates maculatus* and *Duttaphrynus melanostictus* formed the second niche cluster in CCA with dominance of species in areas like Rajwadi, Dhaulvalli-2, and Rameshwar. The second cluster was found to be highly determined by land use pattern. Another group of species including *Uperodon mormorata*, *U. globulosus*,

Table 3: Variation in alpha diversity indices, amphibian density, species richness and endemism recorded across the study sites

Study sites*	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Shannon H' index	1.60	1.99	1.28	1.41	2.02	1.86	0.66	1.55	1.47	1.84	2.02	0.94	1.74	1.92
Evenness index	0.83	0.82	0.90	0.82	0.84	0.71	0.64	0.94	0.87	0.90	0.84	0.64	0.71	0.85
Density/ 100 sq. m	16	38	7	35	39	38	14	7	10	17	22	13	18	17
Observed species	6	9	4	5	9	9	3	5	5	7	9	4	8	8
Endemic species	3	3	3	2	3	4	3	2	2	2	2	1	4	3

* Study site labels are abbreviated as per Table 2

Sphaerotheca pashchima, *S. dobsonii*, *Pseudophilautus amboli*, *Hydrophylax bahuvistara*, and *Indirana chiravasi* formed the third distinct species cluster, representing the forest dwelling niche of amphibians. Environmental variables like canopy cover, mode of tadpole development, habitat specificity, stream persistence, humidity, threat status, and endemism had strong positive correlation with the third niche cluster. *Raorchestes bombayensis* was found to be isolated in the ordination plot because of its restricted range of distribution in the study area.

DISCUSSION

Besides the descriptions of the endemic Seshachari's Caecilian *Gegeneophis seshachari* from Ratnagiri district (Ravichandran *et al.* 2003; Gower *et al.* 2007), there are no records or studies available on amphibian fauna of the coastal plains of Konkan region of Maharashtra. To our knowledge, ours is the first comprehensive account of amphibian fauna from this region. Out of 18 amphibian species recorded from the study area, eight (44%) species are endemic to the Western Ghats. Populations of *G. seshachari* were found to be inhabiting plateau habitat, whereas five anuran species, namely *Uperodon mormorata*, *U. globulosus*, *Indirana chiravasi*, *Pseudophilautus amboli* and *Raorchestes bombayensis* were found to be restricted to the forest habitat (Table 2). In this study, we found *P. amboli* and *R. bombayensis* at a very low altitude, at about 10–15 m above sea level (asl), very close to the Arabian Sea shore.

The Amboli Bush Frog *Pseudophilautus amboli* is currently assessed as Critically Endangered (CR) due to its restricted range of distribution and severely fragmented and declining population (Biju 2004). However, based on records from previous studies (Katwate *et al.* 2013), we believe that this species could have wide distribution across the northern Western Ghats. Areas like Ambolgad, Dhaulvalli-1, Tiware-1, Rajwadi, Dhaulvalli-2, and Anantwadi have been identified as diverse regions with respect to the Shannon and evenness index values. In comparison with the plateau habitat, we found very low amphibian density across forested areas, which might be correlated to the greater availability of amphibian breeding habitats on plateaus. Study areas like Rajwadi, Tiware-2, Dhaulvalli-2, Kasheli, and Rameshwar are of conservation interest, as they have been found to be highly influenced by habitat modifications, as described later.

Gegeneophis seshachari was the only caecilian species we found in the present study (Fig. 7d). This species is known to be the first Asiatic amphibian showing viviparous mode of reproduction (Gower *et al.* 2008). We report the occurrence

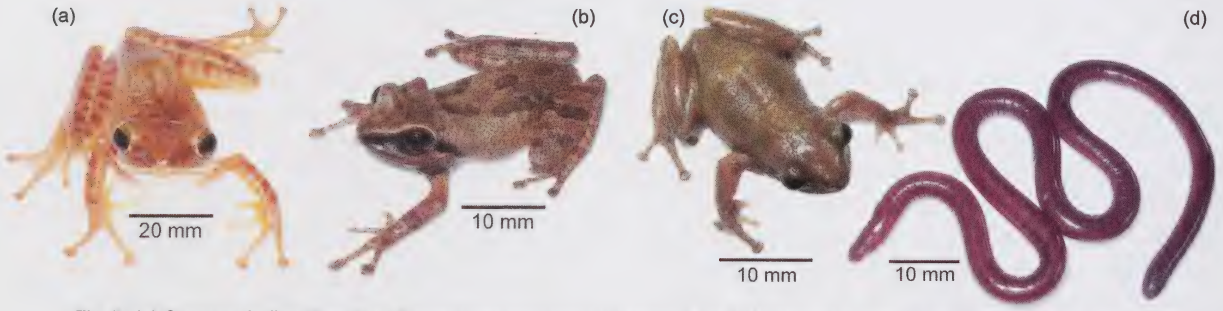

Fig. 7: (a) Common Indian Tree Frog *Polypedates maculatus* (Location: site B/ Ambolgad plateau) was observed to be one of the commonest frogs associated with human habitation; (b) Amboli Bush Frog *Pseudophilautus amboli* (BNHS 5603, Location: site J/ Rajwadi); (c) Bombay Bush Frog *Raorchestes bombayensis* (BNHS 5604, Location: site M/ Kasheli); (d) Data Deficient (DD) *Gegeneophis seshachari* (BNHS 5605, Location: site B/ Ambolgad). Measurements and photographs were taken in the field

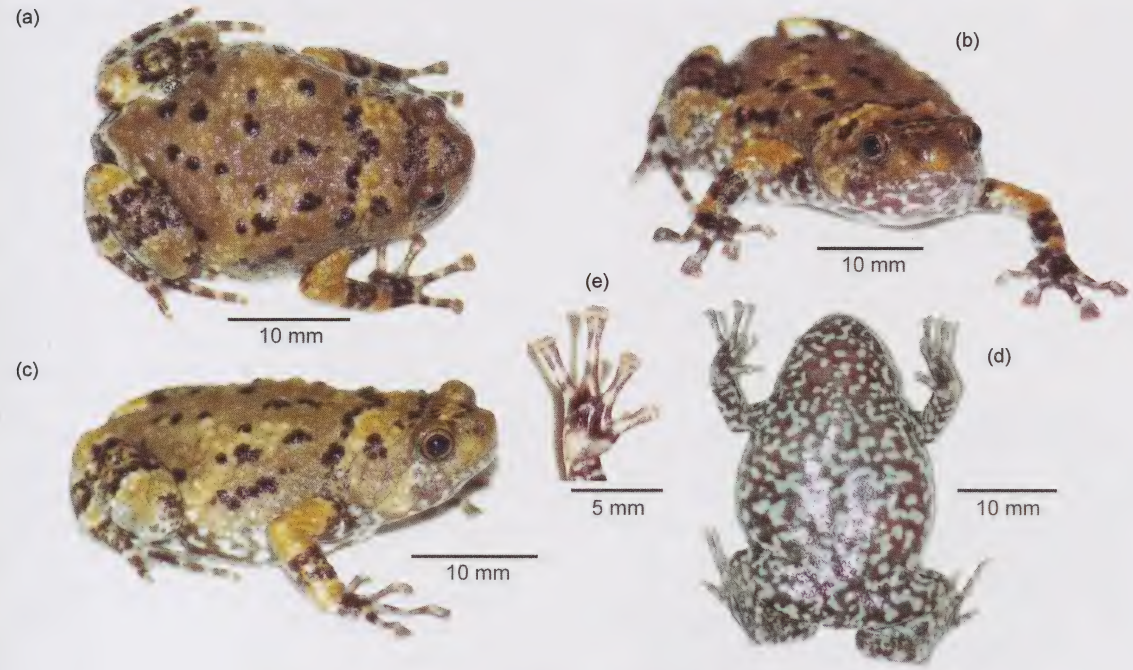

Fig. 8: Marbled Narrow-mouthed Frog *Uperodon mormorata* (BNHS 5606):
(a) Dorsal, (b) anterior, (c) lateral, (d) ventral body aspects, and (e) ventral view of hand.
Measurement and photographs were taken on field

of *G. seshachari* from Ambolgad, Girye-1, and Tiware-1 plateaus, which are located within a radius of approximately 20–30 km from "Dorle", the type locality of *G. seshachari* (Ravichandran *et al.* 2003). After the rediscovery of *G. seshachari* by Gower *et al.* (2007), we provide here the first record of this species from other parts of Konkan (outside the type locality), backed up with voucher specimen and photograph (Fig. 7d, Table 4). Taxonomic confirmation of *G. seshachari* was made by comparing the voucher specimen (BNHS 5605) with the species description given by Ravichandran *et al.* (2003) and Gower *et al.* (2007). Diagnostic characters observed are: lack of secondary annuli and annular grooves, fewer primary annuli in comparison with *G. pareshi* (Giri *et al.* 2011), first nuchal groove almost incomplete mid-ventrally, second nuchal groove seems to be incomplete mid-dorsally, dark purple pink body becoming pale ventrally and grey towards posterior end, eyes visible, head slightly pinkish with visible whitish stripe between eye and tentacle. We found this species in loose soil under boulders and loose rocks. *G. seshachari* has been categorized

Table 4: List of voucher specimens collected at study sites

Sl. No.	Species	BNHS Museum voucher number	Locality in Ratnagiri district	Snout to vent length (SVL) in mm	Date of collection
1	*Pseudophilautus amboli* (Biju & Bossuyt, 2009)	BNHS 5603	Rajwadi	29.0	29.vii.2012
2	*Raorchestes bombayensis* (Annandale, 1919)	BNHS 5604	Kasheli	23.1	02.vii.2012
3	*Gegeneophis seshachari* Ravichandran, Gower & Wilkinson, 2003	BNHS 5605	Ambolgad plateau	138.9	16.vii.2012
4	*Uperodon mormorata* (Rao, 1937)	BNHS 5606	Rajwadi	39.1	14.viii.2012
5	*Uperodon globulosus* (Gunther, 1864)	BNHS 5607	Dhaulvalli private forest area	25.9	14.viii.2012

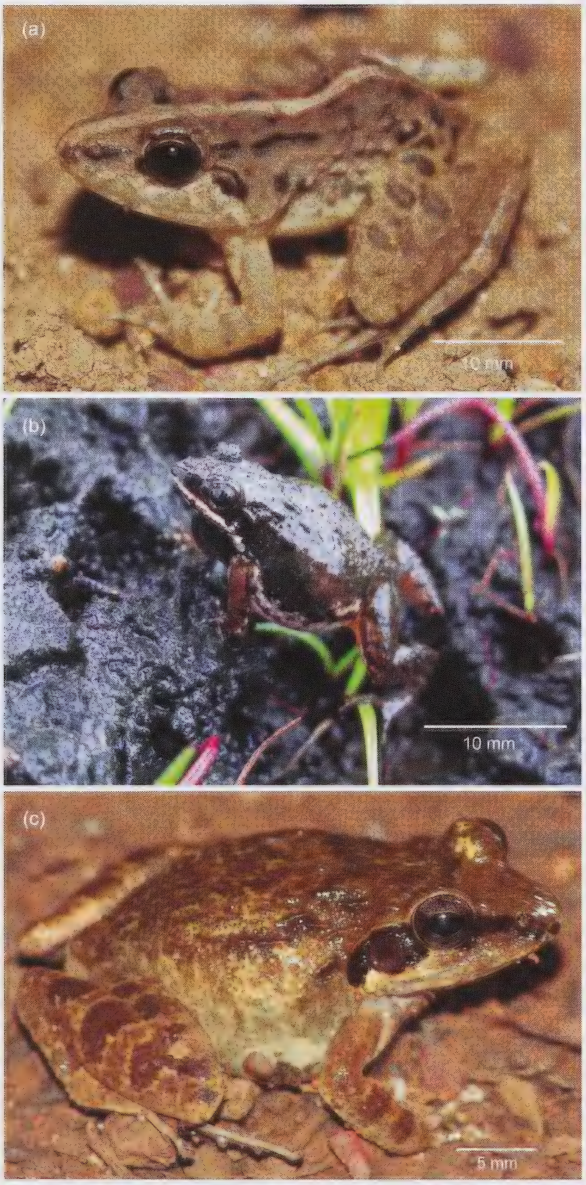

Fig. 9: Sightings of (a) *Minervarya caperata*, from the Ambolgad plateau; (b) *Minervarya gomantaki* from this site Girye-2 plateau; (c) *Indirana chiravasi* from this study site Tiware-2

as Data Deficient (DD), as there is very little information available on its distribution and population (Gower and Wilkinson 2004). In this study, we provide new information on distribution and population status of *G. seshachari*, which can be useful for reassessment of its IUCN Red List status.

In the current study, we also recorded the endemic Marbled Narrow-mouthed Frog *Uperodon mormorata*. The voucher specimen of *U. mormorata* collected from Rajwadi (BNHS 5606, Fig. 8a–e) morphologically matches the descriptions by Garg *et al.* (2018b) and Das & Whitaker (1997). We confirmed the identity of *U. mormorata* based on the following diagnostic characters: dorsum pale olive in colour with dark brown bands behind the internarial, interorbital, and over the scapular region; scattered dark brown blotches present on rest of the dorsum; forelimbs and hindlimbs dark barred; throat, chest, abdomen, and undersides of the forelimbs and hindlimbs variegated with dark brown marbled blotches; eye-snout distance greater than diameter of eye; transverse occipital fold present on head; toes weakly webbed and webbing on toe IV meets the basal subarticular tubercle as a broad sheath; fingers have wide triangular dilations; and dark brown "V" shaped marking on snout.

After the type description of *U. mormorata* from "Sakleshpur" by Rao (1937), this species has been rediscovered from Cotigao Wildlife Sanctuary, Goa and Malabar (broadly Western Ghats) region by Das and Whitaker (1997). Our previous record of *U. mormorata* from Phansad Wildlife Sanctuary, Raigad (Katwate *et al.* 2013) and current records from coastal plateaus of Konkan confirm the identity and distribution of *U. mormorata* in northern Western Ghats. Earlier reports of *U. montana* from parts of Maharashtra like Tamhini, Pune district by Padhye and Ghate (2002) and Dahanukar and Padhye (2005) are probably records of *U. mormorata*, since *U. montana* has a narrow range of distribution in the vicinity of its type locality "Waynaad" in southern Western Ghats (Gururaja 2012). The record of *U. variegata* in Maharashtra by Sekar (1991) also needs to be validated.

We also found a small population of Bombay Bush Frog *Raorchestes bombayensis*. This species has been described by Annandale (1919) from Castle Rock, North Canara, Karnataka. In the type description of *R. bombayensis*, Annandale (1919) reported its geographical occurrence from "Satara (Khas)" i.e. Kaas Plateau in Satara district, and "Poona (Khandala)", now in Pune district, at an altitude between 782 m and 1,219.2 m, and clearly mentioned that it is one of the common species at Kaas and Khandala. In many subsequent studies, *R. bombayensis* has been reported from various forest patches of northern Western Ghats like Bhimashankar, Tamhini, Sinhgad, and Phansad Wildlife Sanctuary (Katwate *et al.* 2013; Dahanukar and Padhye 2005; Padhye and Ghate 2002). However, a recent taxonomic study suggested that the species population reported from Kaas, Khandala, Bhimashankar, Tamhini, and Sinhgad region in fact represents a distinct species, and described it as *Raorchestes ghatei* (Padhye *et al.* 2013). Detailed morphological comparison of our collection (BNHS 5604, Fig. 7c) with the descriptions of *R. bombayensis* and *R. ghatei* suggests that our voucher specimens are somewhat closer to

Fig. 10: Anthropogenic threats observed: (a) large scale mango cultivation; (b) laterite stone quarry; (c) deforestation for mango and cashew cultivation; (d) slash and burn on plateaus

R. bombayensis (Biju and Bossuyt 2009; Padhye *et al.* 2013). In the recent description of *R. bombayensis*, Biju and Bossuyt (2009) diagnosed this species based on collections made from Castle Rock (type locality) and Londa in Karnataka, as well as from Amboli region of Maharashtra. Biju and Bossuyt (2009) state that the collections made by Annandale from Kaas and Khandala in Maharashtra are severely damaged, thus there is an error in validating Annandale's collection of *R. bombayensis* from these localities. Lack of systematic study on the taxonomic validation of *R. bombayensis* has obscured its identity in several parts of northern Western Ghats, which needs to be addressed with major taxonomic revision of this species complex. Taxonomic anomalies reported in the population of *R. bombayensis* from Phansad Wildlife Sanctuary support the necessity for such a study (Katwate *et al.* 2013). As this kind of study is beyond the scope of the present work and considering the morphological similarities of our vouchers with *R. bombayensis* sensu stricto following Biju and Bossuyt (2009), we retain the identity of our specimens as *R. bombayensis*.

We provide here the first report for three species *Minervarya caperata*, *M. gomantaki*, and *Indirana chiravasi* (Fig. 9), which we found considerably northwards of their known distribution ranges. The identity of *Microhyla* species recorded from the study area has been considered as *M. nilphamariensis*, since our study area is overlapping with the distribution range of the species (Garg *et al.* 2018a). However, further taxonomic studies are required to confirm the identity of *M. nilphamariensis* from this region.

Various anthropogenic activities like quarrying (Fig. 10b), deforestation for mango and cashew plantation (Fig. 10a, c), use of excessive pesticides, and intensive grazing were recorded in the study area. The forthcoming nuclear power plant on Jaitapur plateau and associated urbanization and industrialization may pose a threat to locally uncommon species. Anthropogenic activities like quarrying (Fig. 10c and dynamiting on plateaus for mango cultivation may pose a direct threat to fossorial species like *Gegeneophis seshachari*.

Although the duration of our survey was limited to three months, we found considerably rich species diversity in this region. With further systematic study and inventories, we expect records of a greater number of species from this region. The presently known species diversity was found to be

threatened by multiple anthropogenic activities and therefore urgent conservation strategies are required to protect the endemic and threatened amphibian fauna of the region.

ACKNOWLEDGEMENTS

We thank the BNHS field and research staff for helping with the field surveys and collection. We are grateful to Rahul Khot, Curator of Natural History Collection department and Vithoba Hegde, Senior Field Assistant, for their help during the study of the museum specimens and registration of voucher specimens in the BNHS Collection. We thank Rupesh Raut, Asst Professor, Elphinstone College for constructive comments on an earlier draft of the manuscript. We also thank all the local people who allowed us to survey their private forest properties. Lastly, we cannot end without attributing great thanks to Neelesh Dahanukar, IISER, Pune for his extensive help in species identifications, fruitful discussions, and useful comments to improve this manuscript.

REFERENCES

ANNANDALE, N. (1919): The fauna of certain small streams in the Bombay presidency. *Records of the Indian Museum 16*: 109–161.

BIJU, S.D. (2004): *Pseudophilautus amboli*. The IUCN Red List of Threatened Species 2004: e.T58910A11854647. http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T58910A11854647.en. Downloaded on May 31, 2017.

BIJU, S.D. & F. BOSSUYT (2009): Systematics and phylogeny of *Philautus* Gistel, 1848 (Anura: Rhacophoridae) in the Western Ghats of India, with descriptions of 12 new species. *Zoological Journal of the Linnean Society 155*: 374–444. doi: https://doi.org/10.1111/j.1096-3642.2008.00466.x

BIJU, S.D., I.V. BOCXLAER, S. MAHONY, K.P. DINESH, C. RADHAKRISHNAN, A. ZACHARIAH, V. GIRI & F. BOSSUYT (2011): A taxonomic review of the Night Frog genus *Nyctibatrachus* Boulenger, 1882 in the Western Ghats, India (Anura: Nyctibatrachidae) with description of twelve new species. *Zootaxa 3029*: 1–96.

BIJU, S., S. GARG, K. GURURAJA, Y. SHOUCHE AND S.A. WALUJKAR (2014): DNA barcoding reveals unprecedented diversity in Dancing Frogs of India (Micrixalidae, *Micrixalus*): a taxonomic revision with description of 14 new species. *Ceylon Journal of Science (Biological Sciences) 43(1)*: 37–123. doi: http://doi.org/10.4038/cjsbs.v43i1.6850

BOSSUYT, F. & A. DUBOIS (2001): A review of the frog genus *Philautus* Gistel, 1848 (Amphibia, Anura, Ranidae, Rhacophorinae). *Zeylanica 6*: 1–112.

BOULENGER, G.A. (1890): Fauna of British India Including Ceylon and Burma, Reptilia and Batrachia. Taylor and Francis, London.

DAHANUKAR, N. & A. PADHYE (2005): Amphibian diversity and distribution in Tamhini, northern Western Ghats, India. *Curr. Sci. 88(9)*: 1496–1501.

DAHANUKAR, N., N. MODAK, K. KRUTHA, P.O. NAMEER, A.D. PADHYE & S. MOLUR (2016): Leaping frogs (Anura: Ranixalidae) of the Western Ghats of India: An integrated taxonomic review. *Journal of Threatened Taxa 8(10)*: 9221–9288. http://dx.doi.org/10.11609/jott.2532.8.10.9221-9288

DANIEL, J.C. (1963a): Field guide to the amphibians of western India. Part 1. *J. Bombay Nat. Hist. Soc. 60*: 415–438.

DANIEL, J.C. (1963b): Field guide to the amphibians of western India. Part 2. *J. Bombay Nat. Hist. Soc. 60*: 690–702.

DANIEL, J.C. (1975): Field guide to the amphibians of western India. Part 3. *J. Bombay Nat. Hist. Soc. 72*: 506–522.

DANIEL, J.C. & A.G. SEKAR (1989): Field guide to the amphibians of western India. Part 4. *J. Bombay Nat. Hist. Soc. 86*: 194–203.

DAS, I. & R. WHITAKER (1997): A redescription of *Ramanella mormorata* Rao, 1937 (Anura, Microhylidae). *Alytes 15(3)*: 127–132.

DINESH, K.P., S.P. VIJAYAKUMAR, B.H. CHANNAKESHAVAMURTHY, V.R. TORSEKAR, N.U. KULKARNI & K. SHANKER (2015): Systematic status of *Fejervarya* (Amphibia, Anura, Dicroglossidae) from South and SE Asia with the description of a new species from the Western Ghats of Peninsular India. *Zootaxa 3999*: 79–94.

FROST, D.R. (2018): Amphibian Species of the World: an online reference. Version 6.0 (27-02-2019). Electronic Database accessible at http://research.amnh.org/herpetology/amphibia/index.html. American Museum of Natural History, New York, USA.

GARG, S. & S.D. BIJU (2017): Description of four new species of Burrowing Frogs in the *Fejervarya rufescens* complex (Dicroglossidae) with notes on morphological affinities of *Fejervarya* species in the Western Ghats. *Zootaxa 4277 (4)*: 451–490. https://doi.org/10.11646/zootaxa.4277.4.1

GARG, S., A. DAS, R.G. KAMEI & S.D. BIJU (2018a): Delineating *Microhyla ornata* (Anura, Microhylidae): mitochondrial DNA barcodes resolve century-old taxonomic misidentification. *Mitochondrial DNA Part B 3(2)*: 856–861, o: 10.1080/23802359.2018.1501286. https://doi.org/10.1080/23802359.2018.1501286

GARG, S., G. SENEVIRATHNE, N. WIJAYATHILAKA, S. PHUGE, K. DEUTI, K. MANAMENDRA-ARACHCHI, M. MEEGASKUMBURA & S.D. BIJU (2018b): An integrative taxonomic review of the South Asian microhylid genus *Uperodon Zootaxa 4384(1)*: 1–88. http://dx.doi.org/10.11646/zootaxa.4384.1.1

GARG, S., R. SUYESH, S. SUKESAN & S.D. BIJU (2017): Seven new species of Night Frogs (Anura, Nyctibatrachidae) from the Western Ghats Biodiversity Hotspot of India, with remarkably high diversity of diminutive forms. *PeerJ 5*: e3007. https://doi.org/10.7717/peerj.3007

GIRI, V., D.J. GOWER, K. GAIKWAD & M. WILKINSON (2011): A second species of *Gegeneophis* Peters (Amphibia: Gymnophiona: Caeciliidae) lacking secondary annular grooves. *Zootaxa 2815*: 49–58.

GOWER, D. & M. WILKINSON (2004): *Gegeneophis seshachari*. The IUCN Red List of Threatened Species 2004: e.T59554A11962858. http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T59554A11962858 en. Downloaded on May 31, 2017.

GOWER, D.J., V. GIRI & M. WILKINSON (2007): Rediscovery of *Gegeneophis seshachari* Ravichandran, Gower and Wilkinson, 2003 at the type locality (Amphibia: Gymnophiona: Caeciliidae). *Herpetozoa 19(3/4)*: 121–127.

GOWER, D.J., V. GIRI, M.S. DHARNE & Y.S. SHOUCHE (2008): Frequency of independent origins of viviparity among caecilians (Gymnophiona): evidence from the first 'live-bearing' Asian amphibian. *Journal of Evolutionary Biology 21*: 1220–1226.

GURURAJA, K.V. (2012): Pictorial Guide to Frogs and Toads of the Western Ghats. Gubbi Labs LLP, Gubbi. xviii+153 pp.

GURURAJA, K.V. & T.V. RAMACHANDRA (2012): Anuran Diversity and Distribution in Dandeli Anshi Tiger Reserve. ENVIS Technical Report: 37, Energy & Wetlands Research Group, Centre for Ecological Sciences, Indian Institute of Science, Bangalore.

HAMMER, Ø., D.A.T. HARPER & P.D. RYAN (2001): PAST: Paleontological Statistics software package for education and data analysis. *Palaeontologia Electronica 4(1)*: 9.

IUCN (2016): Guidelines for appropriate uses of IUCN Red List Data. Incorporating, as Annexes, the 1) Guidelines for Reporting on Proportion Threatened (ver. 1.1); 2) Guidelines on Scientific Collecting of Threatened Species (ver. 1.0); and 3) Guidelines for the Appropriate Use of the IUCN Red List by Business (ver. 1.0) Version 3.0. Adopted by the IUCN Red List Committee. Downloaded on June 02, 2017. https://cmsdocs.s3.amazonaws.com/keydocuments/Guidelines_for_Appropriate_Uses_of_IUCN_Red_List_Data_ver3_rev1.pdf

IUCN (2018): The IUCN Red List of Threatened Species. Version 2018-2. <http://www.iucnredlist.org>. Downloaded on November 14, 2018.

KATWATE, U., D. APTE & R. RAUT (2013): Diversity and distribution of anurans in Phansad Wildlife Sanctuary (PWS), northern Western Ghats of India. *Journal of Threatened Taxa 5(2)*: 3589–3602. http://dx.doi.org/10.11609/JoTT.o3038.3589-602

MITTERMEIER, R.A., W.R. TURNER, F.W. LARSEN, T.M. BROOKS & C. GASCON (2011): Global biodiversity conservation: the critical role of hotspots. *In:* Biodiversity Hotspots (pp. 3–22). Springer, Berlin, Heidelberg. doi: 10.1007/978-3-642-20992-5_1

MODAK, N., N. DAHANUKAR, N. GOSAVI & A.D. PADHYE (2015): *Indirana salelkari*, a new species of leaping frog (Anura: Ranixalidae) from Western Ghats of Goa, India. *Journal of Threatened Taxa 7(9)*: 7493–7509. http://dx.doi.org/10.11609/JoTT.o4262.7493-509

OLLIER, C.D. & H. SHETH (2008): The High Deccan duricrusts of India and their significance for the 'laterite' issue. *Journal of Earth System Science 117(5)*: 537–551.

OLIVER, L.A., E. PRENDINI, F. KRAUS & C.J. RAXWORTHY (2015): Systematics and biogeography of the *Hylarana* frog (Anura: Ranidae) radiation across tropical Australasia, Southeast Asia, and Africa. *Molecular Phylogenetics and Evolution 90*: 176–192. doi: 10.1016/j.ympev.2015.05.001

PADHYE, A.D. & H.V. GHATE (2002): An overview of amphibian fauna of Maharashtra state. *Zoos' Print Journal 17(3)*: 735–740.

PADHYE, A.D., A. SAYYED, A. JADHAV & N. DAHANUKAR (2013): *Raorchestes ghatei*, a new species of shrub frog (Anura: Rhacophoridae) from the Western Ghats of Maharashtra, India. *Journal of Threatened Taxa 5(15)*: 4913–4931. http://dx.doi.org/10.11609/JoTT.o3702.4913-31

PADHYE, A.D., N. MODAK & N. DAHANUKAR (2014): *Indirana chiravasi*, a new species of Leaping Frog (Anura: Ranixalidae) from Western Ghats of India. *Journal of Threatened Taxa 6(10)*: 6293–6312. http://dx.doi.org/10.11609/JoTT.o4068.6293-312

PADHYE, A.D., A. JADHAV, N. MODAK, P.O. NAMEER & N. DAHANUKAR (2015): *Hydrophylax bahuvistara*, a new species of fungoid frog (Amphibia: Ranidae) from peninsular India. *Journal of Threatened Taxa 7(11)*: 7744–7760. http://dx.doi.org/10.11609/JoTT.o4252.7744-60

PADHYE, A., N. DAHANUKAR, S. SULAKHE, N. DANDEKAR, S. LIMAYE & K. JAMDADE (2017) *Sphaerotheca pashchima*, a new species of burrowing frog (Anura: Dicroglossidae) from western India. *Journal of Threatened Taxa 9(6)*: 10286–10296. http://doi.org/10.11609/jott.2877.9.6.10286-10296

RAO, C.R.N. (1937): On some new forms of Batrachia from S. India. *Proceedings of Indian Academy of Science, Biology 6*: 387–427, pl. 21–31.

RAVICHANDRAN, M.S., D.J. GOWER & M. WILKINSON (2003): A new species of *Gegeneophis* Peters (Amphibia: Gymnophiona: Caeciliidae) from Maharashtra, India. *Zootaxa 350*: 1–8. doi: http://dx.doi.org/10.11646/zootaxa.350.1.1

SEKAR, A.G. (1991): Distribution of amphibian fauna of India. *J. Bombay Nat. Hist. Soc. 88(1)*: 125–127.

VIJAYAKUMAR, S.P., K.P. DINESH, M.V. PRABHU & K. SHANKER (2014): Lineage delimitation and description of nine new species of bush frogs (Anura: *Raorchestes*, Rhacophoridae) from the Western Ghats Escarpment. *Zootaxa 3893*: 451–488.

Recommended Citation

Katwate, Unmesh and Deepak Apte (2019): Amphibian diversity in two different landscapes of Konkan region, northern Western Ghats, India. *J. Bombay Nat. Hist. Soc. 116*: 11–23. doi: 10.17087/jbnhs/2019/v116/115359

ASIATIC CHEETAH *ACINONYX JUBATUS VENATICUS* IN INDIA: A CHRONOLOGY OF EXTINCTION AND RELATED REPORTS[1]

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[1]Accepted March 06, 2019
First published: July 31, 2019 | doi: 10.17087/jbnhs/2019/v116/141806
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The Cheetah in India has been recorded in history from before the Common Era onwards. It was taken from the wild for coursing Blackbuck for centuries, which went towards its depleting numbers through the ages. From the 16th century onwards, detailed records of its interaction with human beings became available as it was recorded by the Mughals and other kingdoms in the Deccan. However, the final phase of its extinction coincided with the British Imperial rule, and the British added to the woes of the animal. Its extinction became inevitable and this paper records the process extensively. The last cheetahs were shot in India in 1947, however, credible reports continued to be recorded from the Indian subcontinent up to the 1990s. This paper also records other related matters, such as a black cheetah, a cheetah attack on a human being, and cheetah material available in India.

Key words: Cheetah, chronology, extinction, British, India, Indian subcontinent

Background

The Cheetah in the Indian subcontinent had a brush with human beings very early on in Ancient times. It was a cat easy to tame, to keep as a pet, and hunt antelope with. This cat does not attack humans as a rule unless provoked, though we have recorded one instance of an unprovoked attack described later in the paper. It is one of the only two cat species which were used for hunting. The other was the Caracal *Caracal caracal* (Hussain 1891: pp. 316–317, 326–327; A.H. Morton *pers. comm*. 1993).

The cheetah is found in cave paintings at Kharvai and Karabad in Madhya Pradesh, as also at Chaturbhujnath in the upper Chambal valley. These paintings are dated between 2500 to 2300 BCE (Divyabhanusinh 1995: p. 6; Divyabhanusinh and Ranjitsinh 2013). Strabo, the geographer of the ancient world and a contemporary of Emperor Augustus (63 BCE–14 CE), has given a detailed description of a royal procession in India. Though his work is dated to the 1st century CE, he relied on earlier records. He noted that it included tame *pardalis* and *leontes* (Jones 1966: p. 122; Mc Crindle 1901: pp. 75–76). The references obviously are to spotted felids and to lions. Only a tame cheetah would walk in processions, as it was easily tamed. No leopard, on the other hand, would walk peacefully among noisy crowds, given its unpredictable and fretful nature. Claudius Aelianus who lived in Rome in the 2nd century CE, a contemporary of Emperor Hadrian, recorded that Indians brought to their king domesticated *pantheras* and *oryxes* with four horns (Mc Crindle 1901: c XIV, p. 144; Scholfield 1959: Vol. III, p. 235). Again, leopards are not likely to give up their fretful nature to be tamed for court appearances. The reference is to cheetahs, whereas the *oryxes* refer to Four-horned Antelope *Tetracerus quadricornis*. It is not out of place to mention here that as late as the early 20th century, Emperor Haile Selassie of Ethiopia kept tame cheetahs and lions while holding court in his palace.

While cheetahs were tamed so early in India, the earliest reference to coursing Blackbuck *Antilope cervicapra* with them is from the 12th century CE from *Manasollasa*, the chronicle of court activities of King Someshvara III of Kalyani, which detailed this mode of hunting (Shrigondekar 1939: 4. 17-15-1724, Vol. II, pp. 303–304). Firoz Shah Tughlaq, Sultan of Delhi (1351–1388), is recorded to have had so many *yuz-palang* – cheetahs, *siahgush* – caracals, and *shir* – lions in his menagerie at one time, along with other animals and birds, that it was beyond human imagination (Hussain 1891: pp. 316–317, 326–327; A.H. Morton, *pers. comm*. 1993). The Mughal Emperor Akbar has been recorded to have kept 1,000 cheetahs in his menagerie and collected as many as 9,000 of them during his half century reign from 1556 to 1605 (Rogers and Beveridge 1980: Vol. I, p. 204; Blochmann 1873: Vol. I, p. 298). Emperor Jehangir recorded in his autobiography the first and only instance upto the 20th century of a cheetah breeding in captivity anywhere in the world, in 1613 CE (Rogers and Beveridge 1980: Vol. I, p. 240). It was an exceptional event, more so as it was accidental as the cheetah slipped out of its collar on its own.

All this goes to show that the range of the cheetah was spread all over the Subcontinent, and they were to be found in substantial numbers. However, while their prey base and habitat survived till much later, removal of cheetahs – both males and females – from the wild in large numbers over centuries, and their inability to breed in captivity during this period, appear to have taken a heavy toll, resulting in their fast depleting numbers by the end of the 18th century. It is not out of place to mention here that throughout Emperor Aurangzeb's reign, which ended in 1707, the Mughal Empire maintained an elaborate administrative set up to catch cheetahs from the wild (Ali 1930: p. 130). Even Tipu Sultan of Mysore was survived by 16 cheetahs, their keepers and paraphernalia, from his menagerie as late as 1799 (Buddle 1990: pp. 22–24) (Fig. 1).

By the time the British started recording their existence from about the last decades of the 18th century, cheetahs were making their last stand, leading upto their total extinction in the Subcontinent towards the end of the 20th century, which leads us to the chronology which follows.

Fig. 1: "Hunting Leopards ready for the chase"
This lithograph was published by Smith, Elder & Co. of London and is dated 1858. The location of the scene is not known, though the fountain design suggests a Mughal garden and the headgear of the cheetah keepers suggests the Deccan

Chronology of Extinction

Arguably the best method to document this march towards extinction in the Subcontinent would be to examine and note as many references to the cheetah in various records as possible. Towards that end, a chronology was prepared by Divyabhanusinh (DS) for his book in 1995 (Divyabhanusinh 1995: pp. 215–223). Its third edition appeared in 2006, in which DS included the new finds he had come across since 1995 (Divyabhanusinh 2006: pp. 196–197). In the meantime, Professor Mahesh Rangarajan came out with his seminal paper on the role of the State in the extermination of the cheetah (Rangarajan 1998). We shall come to his important conclusions later. Raza Kazmi (RK) examined state/provincial level documents of Jharkhand (part of erstwhile undivided Bihar) and neighbouring states, and produced a substantial amount of new material which was published in 2012 (Kazmi 2012). RK continued to research the subject and has come up with yet more records (Kazmi 2014). The authors feel that the time is ripe to combine all the material till date in the chronology which follows (Table 1) and draw conclusions therefrom.

Table 1: Chronology of Extinction

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
2	1772	Surat, Gujarat	Coursing with cheetahs	Forbes, 1813	
	1772	-do-	Two tame cheetahs with author's friend	-do-	2
	1780	Calcutta, West Bengal	One cheetah painted by Zayn-al-din	Kossak, 1997	1
	1799	Mysore, Karnataka	Sixteen cheetahs used by Tipu Sultan, three of them sent to King George III	Buddle, 1990	16
	1800	Calcutta, West Bengal	One cheetah painted for Marquis of Wellesley	Painting in BL	1
2	c. 1800	India	Coursing with cheetahs	Williamson, 1807	
	1803	Thanjavur, Tamil Nadu	One cheetah painted by an artist of Raja Sarfojee of Thanjavur	Painting in BL	1
2	c. 1815	Bangalore, Mysore State, Karnataka	Rajah of Mysore and Hon'ble Mr A.H. Cole (British Resident) send several cheetahs to the races for them to be speared	Bevan, 1839	
	1818	Maharashtra	Six cheetahs speared	Burton, 1959	6

Table 1: Chronology of Extinction (*contd*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
2	c. 1825	Farukkabad (now Farrukhabad), U.P.	Coursing with cheetahs	Johnson, 1827	
	c. 1825	Jalna, Maharashtra	Tame cheetah kills donkey	D'Ewes, 1858	1
2	c. 1827	Agra, U.P.	Coursing with cheetahs	Mundy, 1833	
	1829	Rajkot, Gujarat	One cheetah speared	T.U., 1829	1
	1830	Deesa, Gujarat	Two cheetahs speared	Anonymous, 1830	2
	1830	Sholapur, Maharashtra	Coursing with cheetah named "Lukshmee"	S.M.S., 1830	1
	c. 1835	Chota Nagpur, Jharkhand	Cheetah/hunting leopard exists	Spry, 1837	
2	1835	Agra, U.P.	Coursing with a cheetah seen near Agra	Parks, 1850	
2	c. 1837	India	Coursing with cheetahs	Caunter, 1837	
	1837	Lucknow, U.P.	Two cheetahs accompany Lord Auckland	Dunbar, 1955	2
	c. 1839	Kutch, Gujarat	Cheetahs found in the state of Kutch	Postans, 1839	
2	1839–40	Kulladghee, Karnataka; and found in Bombay Presidency, i.e. Sind (now in Pakistan), Gujarat, and Maharashtra	Saw one tame cheetah; coursing with cheetahs	Hamilton, 1892	1
2	c. 1840	Agra, U.P.	Coursing with two cheetahs	Vigne, 1844	
2	c. 1840	Bharatpur, Rajasthan	Coursing with cheetahs	Orlich, 1842	
2	c. 1840	Punjab	Coursing with cheetahs	Orlich, 1842	
2	1845	Lucknow, U.P.	Coursing with cheetahs	Hoffmeister, 1858	
	1850	Mahall Gorasi, M.P.	One cheetah shot	Fraser, 1881	1
	1850	Burhanpur, M.P.	One cheetah seen	-do-	1
2	c. 1850	Lucknow, U.P.	Cheetah fights as sport	Sharar, 1965	
	c. 1850	Seonee (now Seoni), M.P.	Cheetahs reported	Sterndale, 1877	
	c. 1850	Indore, M.P.	One pet cheetah. One black cheetah seen (details follow in the text)	Wilkinson & Wilkinson, 1896	2
	1852	Kooakhera (Kuvakhera), Rajasthan	One dead cheetah killed by a tiger seen	Rice, 1857	1
	c. 1855	Kathiawar, Gujarat	Five cheetahs seen, chased on horseback in Saurashtra	Rice, 1884	5
	1856	Indore, M.P.	Coursing with two cheetahs	Cummings, 1871	2
2	1857	Banda, U.P.	Coursing with cheetahs	Halliday, 1957	
	c. 1859	Alirajpur, M.P.	One cheetah seen, chased on horseback	Cummings, 1871	1
	c. 1859	Border between Dohad (Gujarat) and Sirdarpur (M.P.)	Two cheetahs seen, one shot	-do-	2
	c. 1860	Jaipur, Rajasthan	Photograph of two cheetahs with keepers	Fabb, 1986	2
	c. 1860	Madurai, Tamil Nadu	Cheetahs reported	Nelson, 1868	
2	c. 1860	Baroda, Gujarat	Coursing with cheetahs	Newall, 1867	
2	c. 1860	India	Coursing with cheetahs common among wealthy Indians; A cheetah's price is between Rs 150/- and Rs 250/-	Shakespear, 1860	

Table 1: Chronology of Extinction (*contd*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
2	c. 1860	Kolhapur, Maharashtra	Coursing with cheetahs	Campbell, 1864	
2	c. 1860	Central India	Several cheetahs shot, but not common	Forsyth, 1889	
	c. 1860	Northern Circars, Hyderabad State (now Andhra Pradesh)	Cheetah "not at all rare", one shot (taped at 7 ft)	Pollok, 1896	1
	c. 1860	South India	Old male cheetah killed near the author's camp (a leopard was also shot by him at the same camp)	McMaster, 1871	1
	c. 1860	Chiccary State (Charkhari State), Bundelkhand (now in U.P.)	Coursing with cheetah (finest cheetah specimen the author saw)	-do-	1
	c. 1860	Bundelkhand(?) (now in U.P.)	One large male cheetah speared by a sportsman the author knew, author saw the skin	-do-	1
10	1863–66	Vizagapatnam, (now Visakhapatnam), A.P.	Rewards paid for 85+ tigers, 365 cheetahs and panthers	Carmichael, 1869	
	1864	Sardarpur, near Dohad, Gujarat	Two cheetahs sighted, one of them shot	-do-	2
	1865	Baroda, Gujarat	Coursing with two cheetahs (leopards mentioned separately)	Rousselet and Buckle, 1882	2
	28th Dec., 1865	Pursad village, Rajasthan	Author sees a cheetah prowling near the camp in search of dogs	-do-	1
	1864–77	Mysore State, Karnataka	Two skins seen	Sanderson, 1878	2
	c. 1867	Jalna, Maharashtra; Sagar, M.P.	Cheetahs met with, observed a pair stalking a nilgai; brought up a cub.	Jerdon, 1867	3
	c. 1867	Central and parts of southern India, Khandesh (Maharashtra), Sind (now in Pakistan), Rajputana (Rajasthan), Punjab	Cheetahs reported	-do-	
	c. 1870	Nellore, A.P.	Cheetahs reported	Boswell, 1873	
	c. 1870	South India	Author's friend kept a tame cheetah	Pollock, 1894	1
	1871	Kottamangalam, Coimbatore, Tamil Nadu, Bolampatti, Coimbatore, Tamil Nadu	Three cheetah skins	Morris, 1936	3
			One cheetah skin		1
	c. 1872	Kutch, Gujarat	One cheetah seen	Stoliczka, 1872	1
	Oct. 1872 to Sept. 1873	North West Provinces (NWP), now U.P.	Eight 'Chitas' killed for reward of Rs 37-8 annas; four 'Tendua' (leopard) also listed separately	NAI, H(P) Jan.1875, A, 286–311, No. 296: H.J.A. Sparks, Offg Under Secy, Oudh, 20th Dec., 1873	8
		Mirzapur district, U.P.			
	1874	Tirunelveli district, Tamil Nadu	16 cheetahs killed for reward of Rs 287/-, at Rs 18/- each, thrice the NWPs rate; leopard and cheetah are listed separately	NAI, H(P), May 1877, A, 60–85, No. 60: C.A. Galton, Secy, 20th Dec., 1876	16
	1874	Modoopore (Madhopur), Murshidabad district, West Bengal	One cheetah killed	Raoul, 1893	1
	1875	Bellary district, Karnataka	Five cheetahs for Rs 61/-, at Rs. 12/- each; 18 leopards too.	NAI, H(P), Dec. 1877, A, 269–92, No. 269; C.G. Master, 21st Sept., 1877	5
	1875	Tirunelveli, Tamil Nadu	16 cheetahs killed; leopards listed separately	-do-	16
	c. 1875	Somij village in Saranda Forests, Jharkhand	Two cheetahs killed	Smith, 1904	2

Table 1: Chronology of Extinction (*contd*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
2	20th Nov., 1875	Baroda, Gujarat	Coursing with cheetahs	Fayrer, 1879	
2	16th Dec., 1875	Madras (now Chennai), Tamil Nadu	Coursing with cheetahs	-do-	
2	21st Jan., 1876	Jammu, Jammu & Kashmir	Coursing with cheetahs	-do-	
	28th Jan., 1876	Agra, U.P.	Cheetah shot	-do-	1
	1876	Madras Presidency	135 cheetahs and 507 leopards killed (the former figure is suspect, except for eight in Bellary where leopards given separately). North Arcot (40), but leopards are not listed separately. The former figure is close to the 1876 one. The total may be taken as 19, as calculated by the author. Coimbatore (21), but no listing of leopards at all.	NAI, H(P), Dec. 1878, A, Nos 249–80, No. 286: Board of Revenue Proceedings, 2nd Aug., 1878	19
	c. 1877	Central India	One cheetah seen	Gerrard, 1903	1
	c. 1877	Palamau, Jharkhand	Cheetahs occasionally found	Hunter, 1877	
	c. 1878	Dhrangadhra, Gujarat	Cheetahs encountered occasionally	Watson, 1878	
	1879	India	Two cheetahs arrive in U.K.	*Saturday Review*, 17th May, 1879	2
	c. 1880	Deccan	Four cheetahs trapped by Vardhis (Pardhis) witnessed by 'Deccan Bear'	*The Asian Age*, 22nd July, 1880, quoted in Seshadri, 1969	4
	c. 1880	Jeraikela village, Jharkhand	Cheetah takes away pet deer	Smith, 1904	1
	c. 1880	Bendee village, Saranda Forest, Jharkhand	Cheetah enters a hut, kills a calf and tries to take it away	-do-	1
	c. 1880	Palamau, Jharkhand	Cheetahs shot in Palamau	Baker, 1887	1
	c. 1880	Punjab, Rajputana, Central India, Deccan	Cheetahs reported	Blanford, 1888	
		Deoghar, Santhal Pargana, Jharkhand	One skin seen	-do-	1
		Sambalpur, Orissa	-do-	-do-	1
	c. 1880	Sind, Rajputana, Punjab, Central, Southern, and N.W. India	Cheetahs reported	Murray, 1884	
	c. 1880	Rajkot, Gujarat	Six cheetahs speared by William Loch; six cheetahs sighted by Col. Edmund A. Hardy out of which he shot one and speared three	Newall, 1887	12
	April, 1880	Visakhapatnam, A.P.	O.B. Irvine, Agent of Governor in Visakhapatnam, and his assistant Willock mauled by the cheetah of Raja of Vizianagaram during a cheetah coursing hunt. Irvine dies of his wounds; the only known record of a human being killed by a cheetah. (Detailed quote follows in the text.)	Anonymous, 1881; Nott, 1886	1

Table 1: Chronology of Extinction (*contd*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
	1880–82	Saranda, Jharkhand	Cheetahs kill seven dogs belonging to Mervin Smith	Smith, 1904	1
	1882	Berrambadi Forest, Mysore (now Karnataka)	Five cheetahs seen; one cheetah shot	Russell, 1900	6
2	1883	Faridkot, Punjab	Coursing with cheetahs	Kinloch, 1885	
	c. 1884	Central, Southern India, north-west from Khandesh through Sind and Rajputana to the Punjab, commonest in Jaipur and Hyderabad (in the Deccan)	Cheetahs reported	Sterndale, 1884	
20	1884	Kathiawar (Saurashtra), Gujarat	Not more than 20 cheetahs left	Fenton c. 1924	
	1884	Tanga (Thanga hills) Kathiawar, Gujarat	Roughly 20 cheetahs believed to survive in this rugged country (See Fenton, c. 1924)	Anonymous, 1935	
	1884–1902	-do-	Nine cheetahs speared/ shot	-do-	9
	c. 1885	Palamau, Jharkhand	One cheetah shot	Baker, 1887	1
	1887	Chhindwara, M.P.	One female and four cheetah sub-adults shot/speared	Hicks, 1910	5
2	1887	Hyderabad, Telangana	Coursing with cheetahs	Larking, 1888	
	1887	Junction of Moyar and Bhavani rivers, west of Sathyamangalam, Coimbatore district, Tamil Nadu	One cheetah shot, five killed for rewards. The area also had wolf, nilgai, bustard, florican, blackbuck, antelope.	Nicholson, 1887	6
		Bhavani taluqa	Cheetah and tiger reported		
	c. 1888	Deoghar, Jharkhand	Cheetah skin seen	Blanford, 1888	1
2	1889	Jaipur, Rajasthan	Coursing with cheetahs	O'Shea, 1890	
	1889	North Arcot (area now split between Tamil Nadu and Andhra)	Two cheetah cubs for a total of Rs 25/- bounty	NAI, H(P) Dec. 1890, A, Nos. 360–407, No. 363, p. 32: H.L. Davidson, Collector, North Arcot to Secy, Board, May 1890	2
	c. 1890	Deoghar, Jharkhand	Two cheetahs shot	Braddon, 1895	2
	c. 1890	Southern India	Cheetahs rare. Author saw cheetahs occasionally, never shot one	Pollock, 1894	2
	1890	Melghat Forest, Maharashtra	Three cheetah skins seen	Burton, 1920	3
	c. 1890	Akola, Maharashtra	One cheetah shot	King Martin, 1935	1
	1890–95	Attikalpur, Mysore (Karnataka)	One cheetah seen	Morris, 1935	1
	1891	Hyderabad, Telangana	Photographs of tame cheetah with four dead blackbuck	Worswick, 1980	1
2	1892–93	Kapurthala, Punjab	Coursing with cheetahs observed	Gardner, 1895	
2	1892–93	Alwar, Rajasthan	Tame cheetahs seen	-do-	
	1892	Akola district, Maharashtra	Lived, bred, preyed on antelope and gazelle, trapped by villagers and upcountry rajas	King Martin, 1935	
2	1892	Hyderabad (Telangana)	Coursing with cheetahs	Jung, 1893	
2	c. 1892	India	Coursing with cheetahs	Kipling, 1892	
	c. 1892	Punjab, Rajputana, Central India upto Bengal	Cheetahs reported	Sanyal, 1892	

Table 1: Chronology of Extinction (*Contd*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
2	1893	Marsan, Aligarh, U.P.	Coursing with cheetahs	Jung, 1945	
	1894	Rajkot, Gujarat	Female cheetah and her four cubs shot (See Fenton, c. 1924)	Anonymous, 1935	
	1894	Dhamangaon, Maharashtra	Two or three cheetahs seen, one shot	Burton, 1920	4
	1894	Melghat forests, Maharashtra	One cheetah shot	Anonymous, 1935	1
	1894–1919	Mirzapur, U.P.	Five cheetahs shot	Allen, 1919	5
	1895	Wano (province not mentioned)	One cheetah shot	Anonymous, 1935	1
	c. 1895	Coimbatore district, Tamil Nadu	A.C. Hill, Divisional Engineer, Madras Railway Company, reared a cub taken from the forests of Coimbatore for coursing	Clay, 1901	1
	c. 1896	South Canara, Karnataka	Author bought a cheetah cub from "a couple of junglewallahs". Raised the said cub for hunting (coursing) in Deccan for three years. Price of a cheetah caught from the wild: "Anything you can agree upon, from ten rupees up."	Clay, 1901	1
	1896	Berar (now Amravati Division), Maharashtra	Two cheetah cubs found, reared	Rodon, 1897	2
	Early 20th century	Nandikottur, Kurnool district, A.P.	Cubs captured; pair of adults, known to Chita Pardhis, a tribe of specialist cheetah trappers	Manakadan, 1988	6
	1901	Madura (now in Tamil Nadu), South Canara (now in Karnataka)	One killed for reward; three more for reward of Rs 50/-	NAI, H(P) Sept. 1902, A, Nos. 281–99, No. 281, pp. 6–7: L. Davidson, Secy, Board of Revenue, 13th March, 1902	4
	1901	South Canara, Karnataka	Three killed, listed in 1903 file	-do-	
	1900–17	Surguja, Chhattisgarh	Two cheetahs shot	Maharaja Madaneshwar Saran Singh Deo of Surguja, *pers. comm.*, 1994	2
	1903	Madura, Tirunelveli, Tamil Nadu	Three cheetahs, no reward paid, one killed, skin taken as trophy	NAI, H(P) Oct. 1903, A, Nos. 237–55, No. 237: Resn., Rev. Dept, 10th March, 1903	4
	1903	South Canara, Karnataka	Three cheetahs, no reward paid	NAI, H(P) Dec. 1904, A, 50–66, No. 50, Rev. Dept, Madras, Proc.: 25th March, 1904	3
	1903	Nowgong, M.P.	One cheetah shot	Stockley, 1928	1
2	c. 1903	Hyderabad, Telangana	Coursing with cheetahs	Forbes-Lindsay, 1903	
	1903–23	Central Provinces (now M.P., Chhattisgarh, and Vidarbha region of Maharashtra)	Three cheetahs procured; cheetahs negligible in number	Dunbar Brander, 1923	3
	1904	Sihawa, Raipur district, Chhattisgarh	Two cheetahs shot	Nelson, 1909	2
	1905	Unknown	One cheetah coursing blackbuck painted	Harrington Bird, 1905	1

Table 1: Chronology of Extinction (*contd*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
	c. 1905	Kothal, Kolhapur, Maharashtra	One cheetah caught	Shahaji Maharaj, 1994	1
	c. 1907	Central India, Rajputana, Punjab	Cheetahs reported	Lydekker, 1907	
	1907	Wankaner, Gujarat	One cheetah shot	M.K. Ranjitsinh, *pers. comm.* 1993	1
	c. 1907	Palamau, Jharkhand	Cheetahs occasionally met with	O'Malley, 1907	
	1910	Ghatbori and Hiwarched Forests (now Maharashtra)	Recorded as present, none killed, 'only a few' in Ajanta hills	Nelson, 1910	2
	1910	Durg district, Hemgir, Orissa	Uncommon	Lowrie, 1910	
	c. 1910	Hemgir, Orissa	Two cheetahs shot, two seen	Cobden-Ramsay, 1910	4
	c. 1910	Palkot, Jharkhand	One cheetah shot	-do-	1
	c. 1910	Palkot and Biru hills, Jharkhand	Cheetahs or "Hallett's Rock Panther" common(?); eight leopards/panthers obtained from this area	Hallett, 1917	
	c. 1910	Wankaner, Gujarat	Two cubs died after capture with mother, latter was released back into the wild	M.K. Ranjitsinh, *pers. comm.*1993	3
2	1911	Hyderabad, Telangana	Coursing with cheetahs	Hardinge, 1933	
	c. 1911	Rewa, M.P.	One cheetah shot by Lord Hardinge	Finn, 1929	1
	1912	Buldana district, Berar, Maharashtra	One cheetah reported, its mate believed trapped by Pardhis, only tracks seen	Burton, 1920	2
	c. 1912	Bellary district, Karnataka	One cheetah caught	Shahaji Maharaj, 1994	1
	1914	Ranipur, Betul, M.P.	Heard of at camp, not seen	King Martin, 1935	1
	c. 1914	Central India	Cheetahs reported	Ajaigarh, 1914	
	c. 1914	Mysore State, Karnataka	Cheetah found	Playne, 1914–15	
	c. 1914	Chikmangalur, Karnataka	Cheetah found	-do-	
2	c. 1915	Patiala, Punjab	Coursing with cheetahs	Baden-Powell, 1915	
	1916	Nagpur, Yavatmal districts, Maharashtra	Permission to trap cheetah for Nizam, Hyderabad. The file is missing in the National Archives of India	IOL, Agri & Forests, p/9912, June 1916, B, 12. BL	
	1916	Mirzapur, U.P.	One cheetah skin	Allen, 1919	1
	1918	Mirzapur, U.P.	One cheetah shot	Anonymous, 1935	1
	1919	Mirzapur, U.P.	One cheetah shot	-do-	1
	c. 1919	Chhindwara district, M.P.	Two cheetahs sighted, one female shot	"Silver Hackle", 1929	2
	c. 1919	North of Bombay Presidency, Sind, Rajputana, northern districts of Central Provinces, possibly Punjab	Cheetahs reported	-do-	
	c. 1920	Northern India, Punjab, Rajputana, Central India, Central Provinces, almost upto Bengal	Cheetahs reported	Burke, 1920	
	c. 1920	Central Provinces	Princes try trapping but fail	Hewett, 1938	
2	c. 1920	India	Coursing with cheetahs	Woodyat, 1922	
	?	India	One skin	Daphne M. Hills, Natural History Museum, London, *pers. comm.* to K.S. Samar Singh, 1984	1

Table 1: Chronology of Extinction (*contd*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
	c. 1923	Nagar-Untari, Garhwa district, Jharkhand	Cheetahs(?) carrying off children from neighbourhood	Tallents, 1926	
	1924	Prabhas Patan, Saurashtra, Gujarat	One cheetah shot	Desai, 1983	1
	1925	Rewa, M.P.	Three cheetahs shot, one cheetah escaped	Bikaner, 1926	4
	c. 1925	Jalna, Maharashtra	A pair of cheetahs reported, one trapped by Pardhis. None seen by author though tracks present	Burton, 1928	1
	1926	Harrari Jagir, Chhindwara, M.P.	One cheetah shot	Richardson, 1929	1
	c. 1926	Palamau, Jharkhand	Cheetah occasionally met with	Tallents, 1926	
	1927	Mirzapur, U.P.	One old cheetah killed, skin examined	Finn, 1929	1
2	c. 1930	Jaipur, Rajasthan	Coursing with cheetahs	Wood, 1934	
10	c. 1932	Gwalior State (now part of M.P.)	50 to 60 cheetahs survive in the State according to the Officer in Charge of the Gwalior Shikar Department	Thompson, 1932	
	c. 1932	Indore State (now part of M.P.)	Cheetahs found	-do-	
	c. 1932	Hyderabad State, Telangana	Indian cheetahs unobtainable in most Princely States, some princes now sourcing them from Hyderabad State	-do-	
	c. 1932	Rajputana, Central India, Central Provinces, Punjab	Cheetahs reported	Alexander & Martin-Leake, 1932	
	1932	Talcher, Orissa	One cheetah shot	Lothian, 1951	1
	?	United Provinces, (now Uttar Pradesh/U.P.)	One cheetah shot while stalking a Sambar	Anonymous, 1935	1
	c. 1934	Hyderabad State	Cheetahs found, live in holes in rocks or among accumulations of rocks and boulders	-do-	
	c. 1935	Seoni plateau, M.P., Saugor (Sagar), M.P. and Berar (now Amravati Division, Maharashtra)	Still believed to exist in parts of these landscapes	-do-	
	c. 1935	Hyderabad State, Telangana	A few cheetahs still remain	Sálim Ali, 1935	
	c. 1935	Palamau, Jharkhand	Cheetahs believed to survive in this area	Houlton, 1949	
	c. 1936	Deccan	Three cheetah skins seen (probably shot much earlier)	Burton, 1936	3
	1936	Surguja, Chhattisgarh	One cheetah shot	Maharaja Madaneshwar Saran Singh Deo of Surguja, *pers. comm.*, 1994	1
	1939	Orissa	One cheetah shot	Anonymous, *pers. comm.*, 1993	1
	c. 1939	India	Cheetahs almost extinct	Pocock, 1939	
	1940	Visavadar, Gir, Saurashtra, Gujarat	One cheetah shot	Desai, 1983	1
	1941	On the boundary of Rewa State, now part of M.P.	Two male cheetahs shot	Van Ingen & Van Ingen, 1942	2
	1947	Koriya State (now Koriya district, Chhattisgarh)	Three cheetahs shot	Van Ingen & Van Ingen, 1948	3

Table 1: Chronology of Extinction (*contd*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
	c. 1948	India	Cheetah's existence doubtful	Prater, 1948	
	1951	Ramgarh, Koriya district, Chhattisgarh	One female cheetah, which appeared pregnant, sighted by Raja Saheb of Korea	M. Ram Chandra Singh Deo of Korea, *pers. comm.* to M.K. Ranjitsinh, 1987	1
	1951	Orissa-Andhra Pradesh border	One cheetah sighted, reports of cheetahs from villagers	Seshadri, 1969	
	1952	Chittoor district, A.P.	One cheetah sighted	Kirkpatrick, 1952	
	1954	Bahawalpur, Pakistan	One cheetah sighted	Stephan, 1954	1
	1957	Hyderabad, Telangana	Cheetah fell into a well	Abid Hussain, *pers. comm.* to DS, 1992	1
	1967	Between Turripani and Ramgarh (both now in Guru Ghasidas National Park), Koriya district, Chhattisgarh	One cheetah sighted	M. Ram Chandra Singh Deo of Korea, *pers. comm.* to M.K. Ranjitsinh, 1987	1
	1968	Turbat, Baluchistan, Pakistan	One cheetah shot	Roberts, 1977	1
	1967–68	Between Surguja (in Chhattisgarh) and Sidhi (in M.P.)	A pair of cheetahs sighted	Maharaja Madaneshwar Saran Singh Deo of Korea *pers. comm.* to Maharawalji Digveerendrasinh of Vansda, 1990	2
	1972	Mekran Coast(?) Baluchistan, Pakistan	One cheetah skin	Roberts, 1977	1
	c. 1975	Danto village, Hazaribagh, Jharkhand	One cheetah sighted	Philomina Imam, *pers. comm.* to Raza Kazmi, 2018	1
	1977–78	Baluchistan, Pakistan	Cheetahs reported	N. Hussain, *pers. comm.*, 2000	
	c. 1985	Baluchistan, Pakistan	One cheetah(?) sighted	-do-	
	1997	Unknown	Cheetah skin coat for sale in Islamabad	-do-	1
	1997	Chagai Plains, Baluchistan, Pakistan	One cheetah shot	-do-	1
	1997	Ormara, Baluchistan, Pakistan	One cheetah seen; one cheetah female with two cubs seen	-do-	4
Total: 108					**Total: 306**

Grand Total: 414

Table 1 gives a figure of 306 cheetahs which were accounted for in the Subcontinent between 1772 and 1997, that is within a time span of two centuries and a quarter. At the outset it is necessary to note that in many cases the dates mentioned in the preceding table are those of the year of publication of the work, as specific dates are not mentioned in many of them. Many cities and towns have been mentioned in the table, such as Calcutta, Lucknow, Rajkot, etc. Such locations signify the surrounding areas where cheetahs were found, or were brought to royal courts, and similar official establishments, and so on.

We have included here only the references to cheetahs seen in specific localities, where they were shot, painted, or their skins were seen, and those for which bounties were paid by the government. There were some instances which looked doubtful initially, but on closer examination we

concluded that they were credible enough for inclusion. An explanation for including some records and not including some in the count of the cheetahs is called for in cases which are detailed below:

Mrs Postans' general record of cheetahs in Kutch, Gujarat of c. 1839 and S.H. Desai's record of a cheetah each in 1924 and 1940 in Kathiawar were discounted by M.K. Ranjitsinh (Ranjitsinh, M.K. *pers. comm.* 1994) and DS earlier, as cases of mistaken identities with leopards. However, F. Stoliczka saw a cheetah in Kutch in 1872, 33 years after Mrs Postans' record. Hence, we have noted her record but not included any number in this count. Similarly, K.M. Kirkpatrick's record of a 1952 sighting in Chittoor district, Andhra Pradesh, has been considered to be doubtful. B. Seshadri too records a sighting of cheetah in 1951 from the Odisha-Andhra border, which is probably the same incident as recorded by Kirkpatrick. Thus, we have not included both Kirkpatrick's and Seshadri's reports in our count.

Fig. 2: Stained glass of a cheetah in an hunting ground. This decorative window was made specifically for Thakor Saheb Jaswantsinhji of Limbdi (Gujarat), c. 1886, and is in the Digbhuvan Palace in the town. Here the cheetah has been brought for the hunt in a palanquin; usually they were transported on a bullock cart. Courtesy: Thakor Saheb Chattrasalsinhji of Limbdi

On the other hand, on examining again Desai's records in his book "Gir" (Desai 1983), it was noted that he has written separate sections on leopards and cheetahs. He states that one was killed near Prabhas Patan in 1924, while another was shot by Police Constable Pirmohmed Najarmohmed in 1940. The animal was 4' 3" in height (this measurement is an error) and 6' 9½" in length. So we have accepted these reports. DS had earlier discarded this record as being doubtful.

Similarly, DS had earlier only recorded 6 cheetahs being referred to by Maj. Gen. D.J.F. Newall (Newall 1887) in his book, but on re-examining the reference the authors found that Maj. Gen. Newall in fact refers to two separate incidents of two different groups of six cheetahs each being pursued between the area of Rajkot and Porbander. In the first case, William Loch, formerly of the 1st Bombay Lancers, speared 6 cheetahs off one horse. In the second instance, sometime later, Newall's friend Col. Edmund A. Hardy chanced upon six cheetahs asleep under a large tree. He shot one of them, speared three others while two escaped. Thus, the tally of cheetahs for this particular reference has been updated to 12 instead of six as it used to be in the earlier works of DS.

We have accepted the figure of 20 cheetahs in Kathiawar (Saurashtra, Gujarat) given by Lt Col. L.L. Fenton, because he knew the area well and had hunted cheetahs in the locality. He goes on to record that from 1884 to 1900, 10 cheetahs were shot by various British Officers. He also records that five more were accounted for by C.A. Waddington, Principal, Rajkumar College; George Hancock, a police officer; himself and others (Fenton c. 1924: pp. 80–81). We have not counted these animals separately, but have included them in the omnibus figure of 20. A stained glass illustration for Kathiawar shows the cheetah being taken to the field in a palanquin, which is unusual (Fig. 2).

There is the tantalizing record of 50 to 60 cheetahs living in Gwalior State, as per the Shikar Khana In-Charge, c. 1930. Records from large princely states are usually accurate enough. However, erring on the safe side, we decided to not add this large figure to our count, but we have given an arbitrary figure of 10 animals only, and have included it in our table. Actually, Jaipur State was known to have obtained cheetahs from the wild from Gwalior State during this period, according to the information given to DS by the late Mohammad Azizuddin, son of one of the last cheetah trainers of Jaipur State, in 1984.

There is an even more tantalizing record from Vizagapatnam district of rewards being paid during 1863 to the first six months of 1866, for not less than 85 tigers, and 365 cheetahs and panthers. Since cheetahs have been mentioned specifically, we cannot ignore this reference. We have, therefore, given an arbitrary figure of 10 animals.

There are several specific references in various sources to localities where coursing with cheetahs was prevalent, but exact numbers of cheetahs are not given. It is not possible to discount these as totally unreliable, because coursing with cheetahs requires a large establishment of space, trained persons, and resources. Hence, such references cannot be baseless. Therefore, we have given an arbitrary figure of two animals per reference. However, to err on the safe side, we have not included in our count all other general references to the existence of cheetahs from various localities, as they do not appear to be records of actual sightings.

If one is to allow just two cheetahs per reference on coursing with cheetahs, add 20 from Kathiawar, another 10 to Gwalior State, and 10 more from Vizagapatnam mentioned above, the earlier mentioned tally of 306 cheetahs would jump to 414 (as in Table 1) during this period. We leave these figures to the judgment of the reader.

Up to the middle of the 20th century, Indian princes and other potentates continued the age old tradition of coursing blackbuck with cheetahs. Most prominent among them were the Chhatrapati Maharaja of Kolhapur State and the Maharaja of Bhavnagar State. Kolhapur had 35 of them in the 1920s (Cutting 1947: p. 167) and there is a photograph of 11 with their keepers in front of their stable (Pathan 1921: p. 17). Bhavnagar had 5 cheetahs in 1940, though earlier they had as many as 30 (Craighead and Craighead 2001: p. 77). DS's research has shown that Indian princes had started importing cheetahs after 1918 from Africa, as very few of them were available in India. These animals have not been included in our count. It is, of course, quite possible that Kolhapur could have had a couple of cheetahs from India, since Chhatrapati Shahaji Maharaj records a cheetah being caught from the wild as late as c. 1912, as will be noticed from the table.

Philomena Imam's report of Hazaribagh, c. 1975, is interesting. She comes from a well-known family of shikaris who later became conservationists. In a casual conversation with RK over her younger days in the village, she started narrating the incident of her encounter with a "chita". Initially, RK thought she was talking of a leopard, but as the story progressed and she described the 'jizz' (general information of size and shape), RK realized that she seemed to be describing a cheetah rather than a leopard. Nonetheless, he showed her a picture of a leopard, which she immediately dismissed, specifying that the cat in the photo was a "tendua bagh", not a "chita bagh" that she was talking about. She then explained how the "chita bagh" was also a spotted cat like the "tendua bagh", but the spots on the former were solid dots like a "bindi", unlike those on leopard which had a yellow area inside their spots. She also kept stressing that the most easily recognizable feature of the "chita bagh", however, was a single black stripe running below each of its eyes up to its mouth, which looked to her like "do aansu" (two tear drops), thus accurately describing the cheetah's tear marks. She finally said that the "tendua bagh" is still seen sometimes by her friends and relatives in the village, but the c. 1975 sighting was the last time she saw a "chita bagh", and has never heard of any of her acquaintances in the village seeing one since either. This is especially interesting to note, since RK's paper also described the first known record of a cheetah from Hazaribagh district, written in 1877 by Sir W.W. Hunter, who described the animal as being known as "sona chita" in the district. RK had also remarked how the first Gazetteer of Hazaribagh, published in 1917, however, had made no mention of cheetahs in the district. This record then becomes, to our knowledge, the last visual record of the cheetah from India.

Then there is the irksome case of cheetahs mentioned by Major Henry Bevan in his two-volume account (Bevan 1839), much of which is on his shikar exploits during his service years in India. He has clearly noted that cheetahs were different from leopards. Yet, throughout his narrative, the descriptions of his shikar locations, behaviour of animals, etc., suggest that what he calls cheetahs were probably leopards. The authors, therefore, have discarded all these references save in two instances. In one, he says that cheetahs were caught by the Raja of Mysore and sent to the races to be speared. In another instance, he describes his participation in coursing blackbuck with three cheetahs.

It is not possible for us to explain all the entries in the table. But each entry of cheetah numbers that we have considered can be evaluated by the reader himself through a perusal of the sources given in the preceding table for each entry.

During the British period, numerous books were written on shikar. Kenneth P. Czech's bibliography (Czech 2003) lists about 1,000 books written and published on big game hunting, small game hunting, pig sticking, etc., in Asia between 1780 and 1980. DS estimates that of these, close to 600 were on the Indian subcontinent. Very few of these books have references or records of cheetahs. An effort has been made to access as many of these as possible, particularly all those that were likely to have material on cheetahs. Similarly, innumerable travelogues, memoirs, etc. were written, which are even more difficult to access, though again an effort was made to reach as many as possible. In addition to travelogues and shikar books, RK examined obscure periodicals, Gazetteers, other government publications, and provincial records, initially focusing on Jharkhand, Bihar, and adjoining states for his 2012 paper and then in subsequent years expanding the scope of the aforementioned sources to a few other states. These gave startling results. Prof. Mahesh Rangarajan's search

through archival material in the National Archives, Delhi, recorded substantial numbers of cheetahs and highlighted the hitherto unknown fact of them being destroyed by bounty hunters at the instance of the government (Rangarajan 1998). A search through regional records across the Subcontinent, an examination of records in regional archives, and material in regional languages would undoubtedly open vast vistas of information. These are, as would be obvious, beyond the reach of the authors. That said, Table 1 given above is the result of decades of compilation and is extensive. If an enquiry is pursued to expand it to search new sources, it is quite possible that a large number of cheetahs would be

Table 2a: Zoological Survey of India, Kolkata (Dr Sujit Chakraborty, Z.S.I, *pers. comm.* 1991)

No.	Specimen No.	Locality	Date of Collection	Collector/Donor	Remarks
1.	2579	Not indicated	12.07.1857	W. Routledge, animal dealer from Calcutta	Skull
2.	2597	-do-	05.08.1875	-do-	Disarticulated skeleton
3.	7271	Africa	Not indicated	Calcutta Zoo	Skull
4.	7349	Not indicated	-do-	-do-	Skull, mandible broken
5.	13011	-do-	-do-	Not indicated	Complete skeleton
6.	15608	-do-	-do-	Babu H.M. Roy	Skull lower jaw
7.	17627	-do-	-do-	Calcutta Zoo	Skull

All our enquiries have established that cheetahs were imported by Indian princes and others in the post 1918 period. Specimen nos. 1 and 2 would be from India.

Table 2b: Indian Museum, Kolkata (Dr A.K. Sanyal, Z.S.I., *pers. comm.* 1994)

No.	Specimen No.	Locality	Date of Collection	Collector/Donor	Remarks
8.	Not indicated	C.P. (Central Provinces, roughly the area of Madhya Pradesh, Chhattisgarh, and Vidarbha region of Maharashtra)	1898	R. Ward & Co.	Fully mounted specimen

The above specimen collected from C.P. in 1898 would be from India.

Table 2c: Bombay Natural History Society, Mumbai

No.	Specimen No.	Locality	Date of Collection	Collector/Donor	Remarks
9.	M.5738 BNHS 6187	Victoria Garden (Veermata Jijabai Bhosale Udyan)	07.viii.1936	Superintendent, Victoria Garden	Skull
10.	M.6081 BNHS 6232	-do-	Not indicated	Not indicated	Skull
11.	M.982 BNHS 6229	Pushtikoh Range, Afghanistan	07.vii.1917	Capt. John Napier	Skull and skin

Specimen no. 11 is the only one of an Asian Cheetah from outside India in the Subcontinent.
(Information collected from BNHS by DS)

Table 2d: Lallgarh Palace, Bikaner

No.	Specimen No.	Locality	Date of Collection	Collector/Donor	Remarks
12.	Not indicated	Rewa, Madhya Pradesh	1925	Maharaja of Bikaner	Skin with mounted head, Male
13.	-do-	-do-	-do-	-do-	-do- Male
14.	-do-	-do-	-do-	-do-	-do- Female
15.	-do-	Serengeti Plains	?	-do-	-do-
16.	-do-	-do-	?	-do-	-do-
17.	-do-	-do-	?	-do-	?

accounted for. After all, finding all of them in their final phase of existence on the Subcontinent within an area of 4,114,770 sq. km over a period of two and a quarter centuries is beyond the capacities of the authors.

On the basis of the tabulated information, the accompanying map shows the range of the cheetah in its final phase of existence on the Subcontinent (Fig. 4). Today, less than 40 cheetahs survive in Iran and none are reported from Fars adjoining Baluchistan (Farahdinia *et al.* 2016). It is, therefore, very unlikely that any may cross over into the Subcontinent now, except perhaps a skin as part of illegal trade.

CHEETAH SKINS, SKULLS, ETC. IN INDIA

It is not out of place to record here the details of cheetah skins, skulls, etc. available in India (Table 2a–d).

Several rich people such as the zamindars of Bengal had menageries of their own, and specimen no. 6 (Table 2a) could be from one such and would be from India. The cheetah skull multivariate analysis done by the late Dr Colin P. Groves showed that the Ward (Table 2a) and Roy (Table 2b) donations fall close to the measurements of an Indian cheetah's skull in the Natural History Museum, London (Colin P. Groves, *pers. comm.* 1991).

Of the six trophies listed in Table 2d, five are displayed on the walls of Lallgarh Palace. Trophies at numbers 12, 13, and 14 (all displayed) are obviously from India. Maharaj Kumar (later Maharaja) Sadul Singhji of Bikaner shot one male cheetah on the "Plains-Tanganika" (Tanzania) in 1932. He shot two more males on "Serengata [sic] Plains" (Serengeti Plains, Tanzania), one in 1933 and another in 1934. DS has seen two of these three trophies in the palace. It is not clear if a third trophy exists. It is not clear which two animals, of the three, the trophies represent. (Information obtained by DS from the Bikaner royal family.)

Tala and Koriya Cheetah trophies

Two cheetahs were shot by the late Th. Mordhajsingh of Tala in 1941 in the territory of a neighbouring state on the border of Rewa State (now in M.P.). Unfortunately, these are lost according to information given by the late sportsman K.K. Singh (*pers. comm.* 1991). One of these was a fully mounted specimen (Van Ingen and Van Ingen 1942).

Maharaja Ramanuj Pratap Singh Deo of Koriya shot three cheetahs within the territory of the former Koriya State in 1947. Two trophies were made of the skins with mounted heads. The present whereabouts of these are not known to the authors. The third was fully mounted. It is now in the Palace at Baikunthpur, Koriya district, Chhattisgarh (M. Ram Chandra Singh Deo, *pers. comm.* to M.K. Ranjitsinh, 1993).

Van Ingen & Van Ingen, Mysuru

This world renowned firm of taxidermists had a complete cheetah skeleton acquired from the Mysore Zoo. The late Mr E. Joubert Van Ingen informed DS in 1991 that this was of an animal from Africa. Since the firm has wound up and the three Van Ingen brothers, De Witte, E. Jobert, and Botha have passed on, the authors could not ascertain the whereabouts of this specimen.

Unique cheetah behaviour and an aberrant form of cheetah

Though what the authors record here is not entirely relevant to the story of the extinction of the cheetah from the Indian subcontinent, two of RK's finds are too important to leave unrecorded.

The authors' searches into cheetah records over the last three decades and more had not revealed a single instance of an unprovoked attack on a human being by a cheetah in captivity. However, there is one instance of an enraged cheetah which turned on a human being. The event has been recorded by J.F. Nott which we quote in toto, for the sake of brevity:

"There are exceptional specimens however, and accidents have happened by placing too much confidence in the harmless character even of these animals, for "Smoothbore", writing to the *Field* in May, 1880, describes a death of one gentleman and serious injury to another. Messrs O.B. Irvine, acting collector of Vizagapatnam, and Mr Willock, also a civilian, went out with the Rajah of Vizagapatnam to hunt antelope with a hunting cheetah. The animal proved sulky and would not hunt, so Mr Irvine proposed they should hunt it. The cheetah was enlarged [released] and was soon lost sight of: but, whilst the party was following it up, the cheetah suddenly sprang from behind a bush, where it was crouching, on Mr Irvine, injuring him severely. Mr Willock came to his assistance, but he also was speedily rendered *hors de combat*. The result was that Mr Irvine died within a couple of days, and for some time it was thought Mr Willock was recovering. Mr Irvine's death is universally regretted, as he was well known and a general favourite throughout the Presidency. I have never heard of an accident of this sort before. The hunting cheetah (*Felis jubata*) is generally a most good-tempered and tractable animal, and is led about with a chain and collar like a dog." (Nott 1886: pp. 94–95)

Coming to aberrant forms of the cheetah, it will be remembered that there has been only one record of a "white" cheetah which arrived at Emperor Jehangir's court in 1608. And there is a report of a "Wooly cheetah" from Beaufort West, Cape Colony, South Africa reported in 1877 which had a "grayish yellow" pelage. These were instances of

albinism and incipient albinism (Divyabhanusinh 2006: pp. 41, 208–209).

The melanistic form of the cheetah, on the other hand, is better known as the King Cheetah which is now bred in captivity in South Arica and elsewhere. However, a totally black cheetah has been reported only once. In their book on their adventures in India, THE MEMOIRS OF THE GEMINI GENERALS, the authors have a separate section on the cheetah. In this section Maj. Gen. Johnson Wilkinson records his brother Maj. Gen. Osborn Wilkinson's account of the latter's friend and a brother army officer, Sir William Turner's encounter with a black cheetah which we quote in toto:

"One day I had, as usual, given the racing horses their gallops, and on proceeding to the house I entered the drawing-room, and found Mrs. E… had just preceded me. She was alone, in abject terror, and scrunched up into the smallest possible space at the corner of her sofa. I observed the tail of some animal protruding from underneath the sofa. It was a cheetah, a species of leopard supposed to be more or less domesticated, I believe, which had escaped from its cage. I at once rushed to the rescue. Catching hold of the tail I dragged the brute from his lair, till I got him well outside the room, and then I let go my hold, and he bolted, where I cannot remember, but I have no doubt he was soon captured and safely lodged in his cage.

"How far these hunting cheetahs are to be trusted I know not; but my Twin's sporting companion and brother officer, Sir William Turner, describes cheetahs or leopards in their wild state as most destructive, 'destroying dogs, goats, bullocks, deer, etc. in great numbers, but like all the rest of the feline tribe, are sneaking, cowardly creatures, seldom appearing except at night, when they spring with tremendous bounds upon their prey, fastening on his throat and easily pulling him to the ground, where they quietly suck his blood. They seldom do more the first night, but having drained his veins retire to their lair for the day, returning the next night to feast upon the carcase. At times they are more daring, and spring upon their prey in broad daylight and close to a village.' In illustration of this animal's want of pluck in face of his enemy, man, I repeat a story told by Sir W. Turner, which, I think, shows that he at all events did not suffer from any such 'want'. He writes, 'I was out walking before breakfast with one of our officers. He had a walking stick and I a gun, which I had just discharged, when a mouse deer sprang out of some bushes and crossed the road in front of us; my dog Whiskey saw it, and immediately gave tongue in chase [barked], but had hardly run a hundred yards when her [*sic*] cry was changed into a sharp yelp, as if in pain or fright. For a moment we stood still, at a loss to imagine what had occurred. Laying down the gun, and snatching my friend's stick, I rushed into the jungle, and again heard [a] short, stifled yelp not far from me. On reaching the spot there stood a black cheetah with his paw upon the dog, curling up his lips with deep low growls. I felt that I was no match for him with a stick, but was determined that he should not have the dog without a fight; and leaping over the intervening bushes struck at the cheetah with the stick. With one bound he was off, leaving the dog lying on the ground. I carried the dog to a tank that was near, and washed the wounds. Although it recovered it was long before I could get it to leave my heels and again take to the jungle. Poor Whiskey! He [*sic*] was taken some months after by an alligator.'

"To return to my tale, the cheetah I tackled made no sort of resistance whilst I was hauling at him, beyond digging his claws into the carpet, just as a refractory dog or cat might do under similar circumstances. At every pull I gave he turned his head towards me slightly, and I think showed his teeth and snarled, as if remonstrating with my unceremonious mode of ejecting him, and this was all he did." (Nott 1886: pp. 101–102).

The passage quoted above makes it clear that the authors knew what they were talking about, though they have called a cheetah as a leopard and included in its prey base a bullock (which is too big to be brought down by a single cheetah though a coalition could do the necessary). Unfortunately, the book does not give the location of the incident. A leopard in any case is not likely to give up its kill to a person on foot armed only with a stick. Further, the small mouth of the cheetah would have been the cause of the survival of the dog. The authors, therefore, conclude that the reference here is to a cheetah.

CONCLUSIONS

It is apparent from the accompanying map that cheetahs continued to be found in very low densities throughout their wide range across the Subcontinent during this period, despite depleting numbers. Also, the map shows that cheetahs in their most preferred habitat such as the grasslands and semi-arid tracts of Kathiawar (Saurashtra, Gujarat) and elsewhere came under severe pressure earlier than those found on the edges of forests, including sal forests and grassy glades within them in Central India.

During this period, cheetahs were subjected to their being taken from the wild for coursing blackbuck by Pardhi tribals and others for their princely patrons. That apart, they were also being targeted by British and Indian "sportsmen", as is evident from the preceding table.

This brings us to Prof. Mahesh Rangarajan's crucial research. His search through archival records found that the

Fig. 3: "The haunts of the cheetah are the low, isolated, rocky, broken grounds bordering the plains." This picture is dated 1885 and was published by Charles E. Clay in 1901 in *Outing* magazine of New York. These are Asiatic cheetahs. Of note are the tips of the tails which are black, unlike most tips of African animals which are white. Clay's article talks of the Deccan region, but does not give the location of the picture

British government gave rewards for the destruction of not only adult cheetahs, but also for their cubs from about 1871 onwards. He points out that not less than 70 of them were killed between then and 1925, which is on an average 1.30 animals per year. Compare this figure with the information from Table 1. A total of 306 were accounted for between 1772 and 1997, that is an average of 1.36 per year, or if we take the larger figure of 414 after adding another 108, then we get an average of 1.84 per year. This was the last stand of a very dispersed, fragmented population. Prof. Rangarajan goes on to point out that the administrative policy of British India "played a major role in its extinction". (Rangarajan 1998). Some observers have also often pointed out the lack of cheetah references in the writings of colonial hunters, and the fact that even the sum total of the scarce colonial records that exist of their killings is a very small number when compared to the number of tigers, leopards, and wolves being killed during the same period. Some of the reasons behind this seeming anomaly are as follows.

First of all, as must be evident by now to the readers, cheetahs were already scarce by the time the British consolidated their rule in India. They had become even scarcer by the time the so-called "golden era" of shikar literature began – around the 1870s and thereafter, right upto the end of British rule – surviving in critically low densities across their range in India (Fig. 3). Thus, encounters with cheetahs of such writers would naturally be uncommon, and so then would be their mention in contemporary hunting literature. Another factor to be considered is that in those days there used to be a lot of ambiguity regarding the nomenclature of cheetahs and leopards. Edward B. Baker, an early author on shikar, suggested that the word "leopard" should be applied to the "cheetah" while what is generally called a "leopard" should only be called a "panther" (Baker 1887: p. 193). Baker's work was one of the standard texts on the wildlife of the Bengal Presidency for decades, and could have caused many other authors – especially the generalist authors of Gazetteers and compilers of various government reports detailing animals destroyed every year across the province – to classify cheetahs as leopards and leopards as panthers. And Baker's opinion was not an isolated one – R.A. Sterndale echoed the same view in his book on the natural history of the Subcontinent (Sterndale 1884: pp. 179–184) and so did a number of other authors across India. Finally, the cheetah was rarely, if ever, considered a "worthy trophy" by most big game hunters, with them preferring the larger cats over the lissom cheetah (Kazmi 2016).

While most of the above factors explain the fewer numbers of cheetah killed, compared to tigers and leopards, a contemporary parallel to this situation can be drawn from the situation of the Asiatic cheetah in Iran. The cheetah population of Iran was estimated at around 400 individuals in the early 1960s. This population, spread over a vast area in Iran in very low densities, despite being in steady decline over the decades, has still managed to survive for close to 60 years now. So it is wholly plausible that a small population of cheetahs (hypothetically not numbering more than a couple of thousand animals across India by the 1850s) could have lingered on for close to a century, till the last three animals were shot in December 1947. There are, though, credible sighting reports as recorded in Table 1 of cheetahs upto the winter of 1967–68, and the one of c. 1975, from India; and DS has obtained records upto 1997 from Pakistan.

The accompanying map shows that the range of the cheetahs was spread all over the Subcontinent, but they were found in small numbers and in isolated groups wherever blackbuck were found. This by itself surely caused them to reach the tipping point towards their doom. That apart, factors mentioned here earlier, such as their removal from the wild for coursing antelope and their inability to breed in captivity until the second half of the 20th century, pushed them further in that direction and sealed their fate. Their habitats and prey survived them, their disappearance was not the cause of the cheetah's extinction. Asia's lions, which

Fig. 4: Range of the Asiatic cheetah during the British period and after in the Indian subcontinent

Key to Fig. 4

S. No. Place Year

1 Surat, Gujarat 1772
2 Calcutta, West Bengal 1780, 1800
3 Mysore, Karnataka 1799, 1864–77, 1914
4 Thanjavur, Tamil Nadu 1803
5 Savanadurga, Karnataka 1812
6 Ryacottah, Tamil Nadu 1812
7 Bangalore, Karnataka 1815
8 Nandidurg, Karnataka 1815
9 Rhowra, Maharashtra 1816
10 Sholapur, Maharashtra 1816, 1830
11 Ajanta Ghat, Maharashtra 1817
12 Khandesh, Madhya Pradesh 1817
13 Nagpur, Maharashtra 1818, 1916
14 Kannur, Karnataka 1819
15 Farrukhabad, Uttar Pradesh 1825
16 Cotiady, Kerala 1825
17 Hunsur, Mysore, Karnataka 1825
18 Agra, Uttar Pradesh 1827, 1835, 1840, 1876
19 Kathiawar, Gujarat 1829–1910, 1884–1902
20 Rajkot, Gujarat 1829, 1880, 1894
21 Deesa, Gujarat 1830
22 Lucknow, Uttar Pradesh 1837, 1845
23 Kulladghee, Karnataka 1839–40
24 Kutch, Gujarat 1839, 1872
25 Bharatpur, Rajasthan 1840
26 Indore, Madhya Pradesh 1850, 1856, 1932
27 Mahall Gorasi, Burhanpur, Madhya Pradesh 1850
28 Seonee (Seoni), Madhya Pradesh 1850, 1925
29 Banda, Maharashtra 1857
30 Jalna, Maharashtra 1858, 1867, 1925
31 Baroda, Gujarat 1860, 1875, 1878
32 Jaipur, Rajasthan 1860, 1889, 1930
33 Kolhapur, Maharashtra 1860
34 Madurai, Tamil Nadu 1860, 1901, 1903
35 Charkhari State, Uttar Pradesh 1860
36 Alirajpur, Madhya Pradesh 1863
37 Sardarpur, Dahod, Gujarat 1864
38 Pursad, Rajasthan 1865
39 Punjab 1867–1900, 1880
40 Sind, Pakistan 1867–1900
41 Etola, Gujarat 1870
42 Nellore, Andhra Pradesh 1870
43 Bolampatti, Kerala 1871
44 Kottamangalam, Tamil Nadu 1871
45 Jafrabad, Jalna, Maharashtra 1871
46 Mirzapur, Uttar Pradesh 1872–73, 1894–1919, 1916, 1918, 1919, 1927
47 Chota Nagpur, Jharkhand 1874
48 Madoopore, Murshidabad, West Bengal 1874
49 Tirunelveli dist., Tamil Nadu 1874, 1875
50 Bellary dist., Karnataka 1875, 1912
51 Madras Presidency, Tamil Nadu 1875, 1876
52 Somij, Jharkhand 1875

S. No. Place Year

53 Jammu, Jammu & Kashmir 1876
54 Dhrangadhra, Gujarat 1878
55 Bendee, Jharkhand 1880
56 Deoghar, Jharkhand 1880, 1888, 1890
57 Sambalpur, Odisha 1880
58 Jeraikela, West Singhbhum, Jharkhand 1880
59 Saranda, West Singhbhum, Jharkhand 1880–82
60 Visakhapatnam, Andhra Pradesh 1880
61 Berambadi, Karnataka 1882
62 Faridkot, Punjab 1883
63 Tanga, Gujarat 1884
64 Palamau, Jharkhand 1877, 1880, 1885, 1907, 1926, 1935
65 Chhindwara, Madhya Pradesh 1887, 1919, 1926
66 Hyderabad, Andhra Pradesh 1887, 1890–1910, 1891, 1892, 1903, 1911, 1914, 1932, 1934, 1935, 1957
67 Moyar-Bhavani River, Tamil Nadu 1887
68 North Arcot, Tamil Nadu 1889
69 Akola, Maharashtra 1890
70 Attikalpur, Karnataka 1890–95
71 Melghat, Maharashtra 1890, 1894
72 Berar, Akola, Maharashtra 1892, 1896, 1910
73 Kapurthala, Punjab 1892–93
74 Dhamangaon, Maharashtra 1894
75 Coimbatore, Tamil Nadu 1895
76 Buldhana, Maharashtra 1896, 1912
77 Marsan, Aligarh, Uttar Pradesh 1896
78 South Canara, Karnataka 1896, 1901, 1903
79 Surguja, Chhattisgarh 1900–17, 1936, 1941
80 Nowgong, Madhya Pradesh 1903
81 Sihawa, Raipur, Chhattisgarh 1904, 1905
82 Kothali, Kolhapur, Maharashtra 1905
83 Wankaner, Gujarat 1907, 1910
84 Durg dist., Chhattisgarh 1910
85 Hemgir, Odisha 1910
86 Palkot, Jharkhand 1910
87 Rewa, Madhya Pradesh 1911–25, 1925, 1927
88 Ranipur, Betul, Madhya Pradesh 1912
89 Chikmangalur, Karnataka 1914
90 Patiala, Punjab 1915
91 Nagar-Untari, Garhwa, Jharkhand 1923
92 Prabhas Patan, Gujarat 1924
93 Jabalpur, Madhya Pradesh 1925
94 Talcher, Odisha 1932, 1939
95 Gwalior State, Madhya Pradesh 1932
96 Deccan, Karnataka 1936
97 Visavadar, Gujarat 1940
98 Koriya, Chhattisgarh 1947, 1951, 1967, 1967–68
99 Chittoor, Andhra Pradesh 1952
100 Bahawalpur, Pakistan 1954
101 Turbat, Pakistan 1968
102 Makran Coast, Pakistan 1972, 1977–78, 1985
103 Danto, Hazaribagh, Jharkhand 1975
104 Chagai Plains, Pakistan 1997
105 Ormara, Pakistan 1997

preferred similar habitats and shared the same range as that of the cheetahs above the River Narmada, became extinct in India (apart from the relict population of the Saurashtra peninsula) long before the cheetah. The last possible report of a lion outside Saurashtra was from Bolan Pass in Baluchistan in 1921 (Pocock 1936).

The cheetah's story in Asia may well be ending, unless they are reintroduced into India from Africa, as Iran's population numbering about 40 – which is on the verge of extinction – receives urgent much needed in-situ and ex-situ protection. It is the only mammal so far lost in the plains of the Indian subcontinent. It would be the flagship species if reintroduced, which would ensure the regeneration and protection of grasslands and semi-arid tracts that are home to faunal and avifaunal heritage of such habitats which have received scant attention from the State in India so far.

ACKNOWLEDGEMENTS

Ms Sunitha Jaykumar of WWF-India prepared the manuscript for publication. Dr Arpit Deomurari, also of WWF-India, prepared the map and its accompanying table. Dr M.K. Ranjitsinh, Professor Mahesh Rangarajan, Mr Ravi Singh of WWF-India, and Dr A.J.T. Johnsingh reviewed the paper, which has greatly enriched it. The authors are indebted to them all for their help and guidance. The paper's shortcomings are, of course, the authors' alone.

ARCHIVES

BL: British Library: Oriental & India Office Collections.

IOL: India Office Library and Records, London: Agriculture and Forests (89912)

NAI, H(P): National Archives of India, New Delhi: Home (Public) Department

REFERENCES

AJAIGARH, SAWAI MAHARAJA SIR RANJOR SINGH OF (1914): Yudhabodha Mrigayabinoda. Standard Press, Allahabad.

ALEXANDER, R.D.T. & A. MARTIN-LEAKE (1932): Some Signposts to Shikar. Bengal Nagpur Railway, Calcutta.

ALI, SÁLIM (1935): The Wild Animals of the Indian Empire and the Problems in their Preservation: No. 8 Hyderabad State. *J. Bombay Nat. Hist. Soc. 38(1)*: 74–83.

ALI, SYED NAWAB (ED.) (1930): *Mirat-i Ahmedi* of Ali Muhammad Khan. Oriental Institute, Baroda, p. 130.

ALLEN, G.O. (1919): Caracal (*Felis caracal*) and Hunting Leopard (*Cynaelurus jubatus*) in Mirzapur, U.P. *J. Bombay Nat. Hist. Soc. 26(4)*: 1041.

ANONYMOUS (1830): Hunting near Deesa. *Oriental Sporting Magazine 1(8)*: 393–395. Henry S. King Co., London, 1873.

ANONYMOUS (1881): Report on the Administration of the Madras Presidency, during the year 1880–81. Government Press, Madras.

ANONYMOUS (1935): The Wild Animals of the Indian Empire and the Problems in their Preservation: Part III. *J. Bombay Nat. Hist. Soc. 37*: 114–115.

BADEN-POWELL, SIR ROBERT (1915): Indian Memories: Recollections of Soldiering, Sport, etc. Herbert Jenkins Ltd, London.

BAKER, EDWARD E. (1887): Sport in Bengal and How, When and Where to Seek It. Ledger, Smith & Co., London.

BEVAN, MAJOR H. (1839): Thirty Years in India, Or a Soldier's Reminiscences of Native and European Life in the Presidencies, from 1808 to 1838. 2 vols. Pelham Richardson, London.

BIKANER, M.K. SADULSINGHJI OF (1926): Big Game Diary. (Unpublished)

BLANFORD, W.T. (1888): The Fauna of British India, Mammalia, Vol. I. Taylor & Francis, London.

BLOCHMANN, H.I. (1873): The Ain-i Akbari by Abul Fazl. Vol. I, 2nd edn, revised and edited by Lt Col. D.C. Phillot. Oriental Reprints, New Delhi, 1977.

BOSWELL, A.C. (1873): A Manual of Nellore. Government Press, Madras.

BRADDON, SIR EDWARD (1895): Thirty years of Shikar. William Blackwood & Sons, Edinburgh.

BUDDLE, ANNE (1990): Tigers Round the Throne: The Court of Tipu Sultan (1750–1799). Zamana Gallery, London.

BURKE, W.S. (1920): The Indian Field Shikar Book. Thacker, Spink & Co., Calcutta.

BURTON, BRIG. GEN. R.G. (1920): The Hunting Leopard (*Cynaelurus jubatus*). *J. Bombay Nat. Hist. Soc. 27(2)*: 397–398.

BURTON, BRIG. GEN. R.G. (1928): Sport & Wild Life in the Deccan: An Account of Big-game Hunting During Nearly Forty Years of Service in India. Seeley Service & Co. Ltd, London.

BURTON, BRIG. GEN. R.G. (1936): The Tiger Hunters. Hutchinson & Co., London.

BURTON, LT. COL. R.W. (1959): The Voice of the Cheetah or Hunting Leopard (*Acinonyx jubatus* Erxleben). *J. Bombay Nat. Hist. Soc. 56(2)*: 317–318.

CAMPBELL, COL. WALTER (1864): My Indian Journal. Edmonston & Douglas, Edinburgh.

CARMICHAEL, DAVID FREEMANTLE (Comp. & Ed.) (1869): A Manual of the District of Visagapatam in the Presidency of Madras. W. Thomas, Madras.

CAUNTER, REV. HOBART (1837): The Oriental Annual: Lives of the Moghul Emperors. Charles Tilt, London.

CLAY, CHARLES E. (1901): The Hunting Leopard of India. *Outing: An illustrated magazine of sport, travel, adventure and country life 37 (October 1900–March 1901)*: 706–709. [Edited by Caspar Whitney. The Outing Publishing Company, New York, London]

COBDEN-RAMSAY, L.E.B. (1910): Feudatory States of Orissa. *Bengal Gazetteers*. Bengal Secretariat Book Depot. Reprinted by Firma K.L.M. Pvt. Ltd, Calcutta, 1982.

CRAIGHEAD, JOHN H. & FRANK C. CRAIGHEAD JR (2001): Life with an Indian Prince. Archives of American Falconry, Bois, Idaho. xx +278 pp.

CUMMINGS, LT. COL. W. GORDON (1871): Wild Men & Wild Beasts: Scenes in Camp and Jungle. Edmondston & Douglas, Edinburgh.

CUTTING, SUYDAM (1947): The Fire Ox and Other Years. Collins, London. 393 pp.

CZECH, KENNETH P. (2003): An Annotated Bibliography of Asian Big Game Hunting Books, 1780 to 1980. Land's Edge Press, St Cloud, Minnesota. 254 pp.

DESAI, SHAMBHUPRASAD HARPRASAD (1983): Gir. Prabhas Prakashan, Junagadh.

D'EWES, J. (1858): Sporting in Both Hemispheres. 2nd edn. G. Routledge

& Co., London.

Divyabhanusinh (1995): The End of a Trail: The Cheetah in India. Oxford University Press, New Delhi.

Divyabhanusinh (2006): The End of a Trail: The Cheetah in India. 3rd edn. Oxford University Press, New Delhi.

Divyabhanusinh & M.K. Ranjitsinh (2013): Lion and Cheetah in India: A Critique. *J. Bombay Nat. Hist. Soc. 110(1)*: 3–21.

Dunbar Brander, A.A. (1923): Wild Animals in Central India. Edward Arnold & Co., London.

Dunbar, Janet (1955): Golden Interlude: The Edens in India, 1836–1842. John Murray, London.

Fabb, John (1986): The British Empire from Photographs: India. B.T. Batsford Ltd, London.

Farahdinia, Mohammad, Hasan Akbari, Morteza Eslami & Mohammad Ali Adibi (2016): A review of ecology and conservation status of Asiatic Cheetah in Iran. *Cats in Iran, Special Issue No. 10, Cat News IUCN/SSC*. Kora, Switzerland.

Fayrer, Sir J. (1879): Notes of the Visits to India of Their Royal Highnesses The Prince of Wales and Duke of Edinburgh 1870–1875-6. Kerby & Endean, London.

Fenton, Lt. Col. L.L. (c. 1924): The Rifle in India, Being the Sporting Experiences of an Indian Officer. W. Thacker & Co., London.

Finn, Frank (1929): Sterndale's Mammalia of India. Thacker, Spink & Co., Calcutta. pp. 96–98.

Forbes, James (1813): Oriental Memories: Selected and abridged from a series of familiar letters written during seventeen years of residence in India, etc. White, Cochrane & Co., London.

Forbes-Lindsay, C.H. (1903): India: Past and Present. Vol. I. The C.H. John C. Winston Co., Philadelphia.

Forsyth, Capt. J. (1889): The Highlands of Central India: Notes on their forests and wild tribes, natural history, and sports. New edn, Chapman & Hall Ltd, London.

Fraser, Lt. Col. T.G. (1881): Record of Sport and Military Life in Western India. W.H. Allen & Co., London.

Gardner, Mrs Alan (1895): Rifle and Spear with the Rajputs: Being the narrative of winter's travel and sport in Northern India. Chatto and Windus, London.

Gerrard, Lt Gen. Sir Montague (1903): Leaves from the Diary of a Soldier and Sportsman. John Murray, London.

Hallett, M.G. (1917): Bihar and Orissa District Gazetteers: Ranchi, Patna. Superintendent, Government Printing, Bihar and Orissa, Patna.

Halliday, Emma (1857): Letter dated 7th April to Spencer Wyndham. Collection of Raleigh Trevelyan.

Hamilton, Gen. Douglas (1892): Records of Sport in Southern India chiefly on Annamullay, Nielgherry and Pulney Mountains, etc. R.H. Porter, London.

Hardinge, Lord (1933): On Hill and Plain. John Murray, London.

Hewett, J.P. (1938): Jungle Trails in Northern India, Reminiscences of Hunting in India. Methuen, London.

Hicks, F.C. (1910): Forty Years Among the Wild Animals of India: From Mysore to the Himalayas. Pioneer Press, Allahabad.

Hoffmeister, W. (1858): Travels in Ceylon and Continental India; including Nepal and other parts of the Himalayas, to the borders of Tibet. William P. Kennedy, Edinburgh.

Houlton, J.W. (1949): Bihar the Heart of India. Orient Longmans, Bombay.

Hunter, W.W. (1877): A Statistical Account of Bengal, Vol. 16, Districts of Hazaribagh and Lohardaga. Trübner & Co., London.

Hussain, Maulvi Vilayat (1891): The Tarikh-i-Firoz Shahi of Shams Siraj Afif. The Asiatic Society, Calcutta.

Jerdon, T.C. (1867): The Mammals of India: A Natural History of all the Animals known to inhabit Continental India. John Wheldon, London.

Johnson, Douglas (1827): Sketches of Indian Shikar with observations on Animals, etc. Robert Jennings, London.

Jones, Horace Leonard (Tr.) (1966): The Geography of Strabo. Harvard University Press. Cambridge, Mass.

Jung, Major Nawab Afsar (1893): Shikar Nama of Nizam, Hyderabad. Tr. by Siraj A. Taher (Unpublished).

Jung, Nawab Qutub Yar (1945): Shikar. Rahimiya Press, Hyderabad. Tr. by Siraj A. Taher (Unpublished).

Kazmi, Raza (2012): Jharkhand's Last Hunting Leopards. Special Feature. *Zoo's Print XXCII(4)*: 1–36.

Kazmi, Raza (2014): The Hunting Leopard of Saranda. *Sanctuary Asia 25(2)*: 44–49.

Kazmi, Raza (2016): Where the wild things were. *Indian Express*, October 02, 2016. New Delhi.

King Martin, D. (1935): The Ways of Man and Beast in India. Wright and Brown, London.

Kinloch, Col. A.A. Alexander (1885): Large Game Shooting in Thibet, The Himalayas and Northern India. Thacker Spink & Co., Calcutta.

Kipling, John Lockwood (1892): Beast and Man in India: A popular sketch of Indian Animals in relation with the People. Macmillan & Co., London.

Kirkpatrick, K.M. (1952): A Record of the Cheetah *(Acinonyx jubatus* Erxleben) in Chittoor District, Madras State. *J. Bombay Nat. Hist. Soc. 50(4)*: 931–932.

Kossak, Steven (1997): Indian Court Painting: 16th–19th Century. The Metropolitan Museum of Art, New York.

Larking, Col. Cuthbert (1888): Bandobast and Khabar: Being reminiscences of India. Hurst and Blackett Ltd, London.

Lothian, Sir Arthur Cunningham (1951): Kingdoms of Yesterday. John Murray, London.

Lowrie, A.D. (1910): Central Provinces, District Gazetteers, Drug District. Vol. A, Descriptive. B.M. Press, Calcutta.

Lydekker, R. (1907): The Game Animals of India, Burma, Malaya and Tibet. 2nd edn. Revised by J.G. Dollman, Rowland Ward Ltd, London, 1924.

Manakadan, R. (1988): 'Shikaris of Nandikottur'. *Hornbill (2):* 18–20.

Mc Crindle, John Watson (1901): Ancient India as described in Classical Literature. Philo Press, Amsterdam, 1971.

McMaster, Andrew Cooke (1871): Notes on Jerdon's Mammals of India. Higginbotham, Madras.

Morris. R.C. (1935): Distribution of the Hunting Leopard (*Acinonyx jubatus* Erxl.) in South India. *J. Bombay Nat. Hist. Soc. 38(2)*: 386–387.

Morris. R.C. (1936): Further record of the distribution of the Cheetah (*Acinonyx jubatus* Erxl.) in South India. *J. Bombay Nat. Hist. Soc. 38*: 610.

Mundy, Captain (1833): Pen and Pencil Sketches, being the Journal of a Tour of India. Vol. I, 2nd edn. John Murray, London.

Murray, James (1884): The Vertebrate Zoology of Sind: A systematic account of all the known species of mammals, bird and reptiles inhabiting the province. Richardson & Co., London.

Nelson, J.H. (1868): The Madura Country – A Manual. Asylum Press, Madras.

Nelson, A.E. (1909): Central Provinces, District Gazetteers, Raipur District, Vol. A, Descriptive. Byculla Press, Bombay.

Nelson, A.E. (1910): Central Provinces, District Gazetteers, Buldana District, Vol. A, Description. B.M. Press, Calcutta.

Newall, Capt. J.T. (1867): Hog-Hunting in the East and other Sports. Tinsley Brothers, London.

Newall, Maj.-Gen. D.J.F. (1887): The Highlands of India: Vol. II, being a chronicle of field sports and travel in India. Harrison & Sons, London.

NICHOLSON, F.A. (1887): Madras District Manuals. Vol. II. Edited by Rev. H.A. Stuart, Coimbatore, Madras.

NOTT, JOHN FURTUNE (1886): Wild Animals Photographed and Described. Sampson Low, Marston, Searle & Rivington, London.

O'MALLEY, L.S.S. (1907): Bengal District Gazetteers: Palamau. The Bengal Secretariat Book Depot, Calcutta.

ORLICH, LEOPOLD VON (1842): Travels in India, including Sind and the Punjab. 2 vols. Longman, Brown, Green and Longmans, London.

O'SHEA, F. BERNARD (1890): A Winter Tour in India and Ceylon with a Kathiawar Prince. Times of India Steam Press, Bombay.

PATHAN, A.R. (1921): Kolhapur Shikar Album containing Beautiful Illustrations of Wild Beasts and Birds. A.R. Pathan, Royal Photographer, Kolhapur.

PARKS, FANNY (1850): Wanderings of a Pilgrim in Search of the Picturesque, During Four and Twenty Years in the East; with Revelations of Life in the Zenana. 2 vols. Pelham Richardson, London.

PLAYNE, SOMERSET (COMPILED BY), BOND, J.W. (ASSISTED BY) AND WRIGHT, ARNOLD (EDITED BY) (1914–15): Southern India: Its History, People, Commerce, and Industrial Resources. The Foreign and Colonial Compiling and Publishing Co., London.

POCOCK, R.I. (1936): The Lion in Baluchistan. *J. Bombay Nat. Hist. Soc. 38(2)*: 381–382.

POCOCK, R.I. (1939): The Fauna of British India including Ceylon & Burma. Mammalia. Today & Tomorrow's Printers & Publishers, New Delhi, Reprint 1985.

POLLOCK, LT. COL. A.J.O. (1894): Sporting Days in Southern India: Being reminiscences of twenty trips in pursuit of game, chiefly in the Madras Presidency. Horace Cox, London.

POLLOK, FITZ WILLIAM THOMAS (1896): Fifty Years' Reminiscences of India; A Retrospect of Travel, Adventure and Shikar. Edward Arnold, London & New York.

POSTANS, MRS MARIANNE (1839): Cutch; or Random Sketches taken during a residence in one of the northern provinces of Western India, etc. Smith, Elder & Co., London.

PRATER, S.H. (1948): The Book of Indian Animals. Bombay Natural History Society, Bombay.

RAOUL (1893): Reminiscences of Twenty years 'Pig sticking in Bengal'. W. Thacker Spink & Co. Calcutta.

RANGARAJAN, MAHESH (1998): The role of administration in extinction: fresh evidence of the Cheetah (*Acinonyx jubatus)* in India. *J. Bombay Nat. Hist. Soc. 95(2)*: 328–332.

RICE, WILLIAM (1857): Tiger-shooting in India: Being an account of hunting experiences on foot in Rajpootana during the hot season, from 1850 to 1854. Smith, Elder & Co., London.

RICE, WILLIAM (1884): "Indian Game," (From Quail to Tiger). W.H. Allen & Co., London.

RICHARDSON, J.M. (1929): The Hunting Leopard (*Cynaelurus jubatus*) in the Central Provinces. *J. Bombay Nat. Hist. Soc. 34(1)*: 235.

ROBERTS. T.J. (1977): The Mammals of Pakistan. Ernest Benn Ltd, London.

RODON, MAJOR G.S. (1897): The Young of the Hunting Leopard. *J. Bombay Nat. Hist. Soc. 11*: 544–546.

ROGERS, ALEXANDER & HENRY BEVERIDGE (1980): The Tuzuk-i-Jahangiri or Memoirs of Jahangir. Munshiram Manoharlal Pvt. Ltd, New Delhi, 1980.

ROUSSELET, LOUIS & LT. COL. CHARLES RANDOLPH BUCKLE (1882): India and its Native Princes, Travels in Central India and in the Presidencies of Bombay and Bengal. Bickers and Son, London.

RUSSELL, C.E.M. (1900): Bullet and Shot in Indian Forest, Plain, and Hill. W. Thacker and Co., London.

SANDERSON, G. (1878): Thirteen Years among the Wild Beasts of India: Their Haunts and Habits from Personal Observation; With an Account of the Modes of Capturing and Taming Elephants. W.H. Allen & Co. Ltd, London.

SANYAL, RAM BRAHMA (1892): A Hand-Book of the Management of Animals in Captivity in Lower Bengal. Bengal Secretariat Press, Calcutta.

SCHOLFIELD, A.F. (TR.) (1959): Aelian: On the Peculiarities of Animals. Harvard University Press, Cambridge, Mass.

SESHADRI, BALAKRISHNA (1969): The Twilight of India's Wildlife. John Baker Publishers, London.

SHAHAJI MAHARAJ, MAJ. GEN. H.H. CHHATRAPATI (1994): His Highness Shri Shahu Chhatrapati Maharaja's Shikar and Conservation. *In*: P.B. Salunkhe (Ed.): Chhatrapati Shahu, the Pillar of Social Democracy. Government of Maharashtra Education Department, Bombay, pp. 220.

SHAKESPEAR, CAPT. HENRY (1860): The Wild Sports of India: With remarks on the breeding and rearing of horses, and the formation of light irregular cavalry. Smith, Elder & Co., London.

SHARAR, MAULANA ABDUL HALIM (1965): Guzashta Lucknow. Lucknow Bhuvan Vani Trust, Lucknow.

SHRIGONDEKAR, G.K. (Ed.) (1939): Mānasollāsa of King Somesvara. Vol. II. Oriental Institute, Baroda.

'SILVER HACKLE' (A.G. SUTTLEWORTH) (1929): Jungle Lore and the Rifle: Being notes on shikar and wild animals. Thacker, Spink & Co., Calcutta.

S.M.S. (1830): Description of the Hunting Leopard. *The Oriental Sporting Magazine II(X)*: 7–9. Henry S. King & Co., London, 1873.

SMITH, MERVYN A. (1904): Sport and Adventure in the Indian Jungle, with illustrations from original drawings and photographs. Hurst & Blackett Ltd, London.

SPRY, HENRY HARPUR (1837): Modern India; with illustrations of the resources and capabilities of Hindustan. 2 vols. Vol. I. Whittaker & Co., London.

STEPHAN, IAN (1954): Bahawalpur State. *Geographical: The Royal Society Magazine*, November, p. 328.

STERNDALE, ROBERT A. (1877): Seonee or Camp Life on the Satpura Range; a tale of Indian adventure. Sampson Low, Marston, Searle & Rivington, London.

STERNDALE, ROBERT A. (1884): Natural History of the Mammalia of India and Ceylon. Thacker, Spink & Co., Calcutta.

STOCKLEY, LT. COL. C.H. (1928): Big game shooting in the Indian Empire. Oxford University Press, Bombay.

STOLICZKA, F. (1872): Notice of the mammals and birds inhabiting Kachh. *Journal of the Asiatic Society of Bengal XLI (CLXXVII)*: 211–260.

TALLENTS, P.C. (1926): Bihar and Orissa District Gazetteers: Palamau. Rev. edn. Superintendent, Government Printing, Patna.

THOMPSON, EDWARD (1932): *London Times* (as quoted in Extinct and Vanishing Mammals of the Old World. American Committee for International Wild Life Protection, New York, 1945).

T.U. (1829): Cheetah Hunt. *The Oriental Sporting Magazine 1(3)*: 103–105. Henry S. King & Co., London, 1873.

VAN INGEN & VAN INGEN (1942): Letter to the Curator, Natural History Museum, Darjeeling. *Journal of the Bengal Natural History Society 16*: 72–76.

VAN INGEN & VAN INGEN (1948): Interesting Shikar Trophies: Hunting Cheetah *Acinonyx jubatus* (Schreber). *J. Bombay Nat. Hist. Soc. 47(4)*: 718–719.

VIGNE, G.T. (1844): Travels in Kashmir, Ladakh, Iskardo, the Countries adjoining the mountain-course of the Indus, and the Himalaya, north of the Panjab. 2 vols. Vol. I. Indus Publications, Karachi, 1987.

WATSON, MAJOR J.W. (1878): Statistical Account of Dhrángadhrá; being the Dhrángadhrá contribution to the Káthiáwár portion of the Bombay Gazetteer. Education Society Press, Byculla, Bombay.

WILKINSON, OSBORN & JOHNSON WILKINSON (1896): The Memoirs of the Gemini Generals, Personal Anecdotes, Sporting Adventures and Sketches of Distinguished Officers. A.D. Innes & Co., London.

WILLIAMSON, CAPT. THOMAS & Samuel Howitt (1807): Oriental Field Sports; being a complete, detailed and accurate description of the wild sports of the East. Edward Orme, London.

WOOD, LT COL. H.S. (1934): Shikar Memories: A record of sport and observation in India and Burma. H.F. & G. Witherby, London.

WOODYAT, MAJ. GEN. NIGEL (1922): My Sporting Memories: Forty Years with Note Book and Gun. Herbert Jenkins Ltd, London.

WORSWICK, CLARK (1980): Princely India, Photographs by Raja Deen Dayal, 1884–1910. Hamish Hamilton, London.

Recommended Citation

Divyabhanusinh and Raza Kazmi (2019): Asiatic Cheetah *Acinonyx jubatus venaticus* in India: A Chronology of Extinction and related reports. *J. Bombay Nat. Hist. Soc. 116*: 24–45. doi: 10.17087/jbnhs/2019/v116/141806

A STUDY ON AVIAN FAUNA AT PIPLIYAPALA REGIONAL PARK, INDORE, MADHYA PRADESH, INDIA[1]

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[1]Accepted February 13, 2019
First published: August 30, 2019 | doi: 10.17087/jbnhs/2019/v116/129405
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Urban habitats in the form of parks and gardens support a large population of birds, but their presence in cities is usually overlooked. Hence, an attempt was made to record the species diversity at Pipliyapala Regional Park, Indore. This is the first ever avifaunal study carried out at the Park, where a total of 79 species of birds belonging to 15 orders and 40 families were recorded. Of these 79 species, 64 were found to be resident and 15 were winter visitors. Only one species was found to be IUCN-listed, i.e. River Tern in the Near Threatened category (NT). A total of 21 species of birds were recorded breeding inside the Park. The results of Relative Diversity (RD) Index showed that the Family Ardeidae (RD value = 8.8) was dominant in the Park. Interestingly, Bonelli's Eagle was recorded for the first time in this area. Seasonal variation was observed in a few resident bird species, suggesting their local movement. Breeding of some species and the presence of a large number of migratory species in the Park during winter reflects its good ecological health. However, unwanted human interference and the menace of stray animals were also noted.

Key words: Breeding birds, Relative Diversity Index, Resident birds, Seasonal variation, Winter visitors

INTRODUCTION

Birds are bio-indicators that can be used to assess the health of an ecosystem (Koskimies 1989). Urban habitats play an important role as they support large populations of various life forms, including birds (Davies *et al.* 2008; Fuller *et al.* 2007). Urban landscapes, though they may have low species diversity, play a crucial role in supporting biodiversity as they are "Species Abundant Zones" (Menon *et al.* 2012).

Birds are among the most adaptive and widely spread organisms on the planet, and this ability depends upon their body mass and feeding habits, because of which they have followed human colonization. Due to a higher degree of adaptability in some successful species, their density is much higher in the cities than in the more natural adjacent habitats (Seress and Liker 2015). Studies have also found that bird diversity is usually richer towards the periphery rather than the centre of the city (Sandström *et al.* 2006). Urban populations of birds are more adaptive, both physiologically and behaviourally, than rural bird populations, and have altered their behaviour in order to thrive in urbanized areas. Changes in diet pattern, breeding, foraging pattern, and tolerance to humans are some of the adaptive traits of urban birds (Shochat *et al.* 2010). According to Bonier *et al.* (2007), these adaptive traits and the behavioural, physiological, and ecological flexibility of urban bird populations has helped them adapt over time to adverse urban conditions. Seress and Liker (2015), in their studies on the effects of habitat urbanization on birds, found that the negative effects of urban habitat on bird populations far outweighed the positive effects. Therefore, birds with higher adaptability and no specific diet or breeding requirement were able to survive easily and were more abundant in such habitats than those with specific needs.

It is seen that vegetation plays a vital role in the richness and abundance of birds in urban habitats. Parks, gardens, or areas with more native plant species are more species rich and diverse than areas which have exotic vegetation (Silva *et al.* 2015). The bird composition of a site depends on its vegetation, with greater bird diversity seen to be associated with more complex vegetation (Basavarajappa 2006). Hence, forest lands or any urban green spaces with a combination of herbs, shrubs, grasses, and trees have higher bird diversity than areas with less diverse vegetation, as they provide food, nesting places, and protection against predators for birds at different trophic levels (Bagde 2015; Sharma and Shukla 2015; Vishwakarma *et al.* 2014). However, the major influencing factor on the composition and distribution of bird species in an urban habitat is direct human intervention (Jain *et al.* 2005).

Urban species have a higher tolerance to humans than rural ones and do not fly away easily when approached, but unfortunately, avifaunal diversity is decreasing due to the destruction of their natural habitat and other human activities. Many species are forced to adapt to human-made artificial habitats and to live in urban environments. The landscape of Indore city consists of a broad-spectrum environment, ranging from city greens to highly modified artificial habitats. We conducted a thorough review of the literature and studies on Pipliyapala Regional Park, and found that its avian diversity and breeding birds had received very little attention. Hence, the present study was conducted with an aim to prepare a checklist of avian species of the Park, and to determine the number of bird species breeding in the Park. The study includes seasonal variation, breeding, and migratory status of birds. Thus, based on this study, the ecological health of the Park can be determined.

STUDY AREA

Pipliyapala Regional Park, also known as Atal Bihari Vajpayee Park or Indore Regional Park, was developed by the Indore Development Authority (IDA). The total area of the Park is 80 acres, of which 42 acres are occupied by Pipliyapala Lake and the remaining 38 acres by parkland. A canal passes through the centre of the Park. There are many species of exotic plants in the Park, but the majority area has local vegetation. Bilavali Lake, which lies adjacent to the Park (22.6790° N, 75.8556° E), is a major tourist attraction, and also supports many species of birds and animals, especially during hot summer days.

MATERIAL AND METHODS

To study the avifauna of the selected site, monthly observations were conducted from January 2016 to December 2016. At least 5 faunistic surveys were done each month, at intervals of 5–6 days, totalling 60 surveys for identifying the bird species. Observations and sighting records of birds were taken from the entire Park. Identification was done using Ali (2002), Grimmett *et al.* (2011), and Grewal *et al.* (2016). Bird species were recorded and identified based on sighting, photographs, and calls.

Surveys were done by trekking on fixed track roads going through the Park. Timed Species Count (TSC) method was used twice in 02 hours, one from the starting point of the track to the end point (01 hour) and again from the end point of the track to the starting point (01 hour). In Timed Species Count method, 10-minute series were made, totalling 6 series per hour (Bibby *et al.* 2012). The following formula was used to determine the per cent occurrence of families, or relative diversity of families (Datta 2016):

$$\text{Relative diversity} = \frac{\text{No. of species of each family}}{\text{Total no. of different species seen}} \times 100$$

RESULTS AND DISCUSSION

In the present study, a total of 79 species belonging to 15 Orders and 40 Families were recorded at Pipliyapala Regional Park. Of these 79 species, 64 were found to be resident, and 15 were winter visitors (Table 1). A total of 21 species of birds belonging to 5 Orders and 16 Families were found breeding in the park. Breeding was recorded based on the following evidences: Presence of juveniles, birds carrying nesting material, parent bird carrying food in the beak for young ones, birds seen mating, and presence of nests (also bird incubating or chicks seen in the nest) (Tables 2 and 3). The nesting site and materials used for making the nest were also studied during the breeding season (Tables 2 and 3). Out of 79 species, one species, i.e. River Tern, was found to be in the Near Threatened category of IUCN (International Union for Conservation of Nature) (BirdLife International 2016) as described by Chandra *et al.* (2015) and Kushwaha *et*

Table 1: Avifauna recorded at Pipliyapala Regional Park (Indore region) during the study period [(HBW BirdLife International (2017)]

S. No.	Order/Family/Common Name	Scientific Name	Residential Status	IUCN Status (2017)
	Order Suliformes			
	Family Phalacrocoracidae			
1	Great Cormorant	*Phalacrocorax carbo*	R	LC
	Order Pelecaniformes			
	Family Ardeidae			
2	Great White Egret	*Ardea alba*	R	LC
3	Purple Heron	*Ardea purpurea*	R	LC
4	Grey Heron	*Ardea cinerea*	R	LC

Table 1: Avifauna recorded at Pipliyapala Regional Park (Indore region) during the study period (*contd*)

S. No.	Order/Family/Common Name	Scientific Name	Residential Status	IUCN Status (2017)
5	Black-crowned Night-Heron	*Nycticorax nycticorax*	R	LC
6	Indian Pond-Heron	*Ardeola grayii*	R	LC
7	Cattle Egret	*Bubulcus ibis*	R	LC
8	Little Egret	*Egretta garzetta*	R	LC
	Order Accipitriformes			
	Family Accipitridae			
9	Black-winged Kite	*Elanus caeruleus*	R	LC
10	Black Kite	*Milvus migrans*	R	LC
11	Shikra	*Accipiter badius*	R	LC
12	Bonelli's Eagle	*Aquila fasciata*	R	LC
13	Western Marsh-Harrier	*Circus aeruginosus*	WV	LC
	Order Galliformes			
	Family Phasianidae			
14	Indian Peafowl	*Pavo cristatus*	R	LC
	Order Gruiformes			
	Family Rallidae			
15	White-breasted Waterhen	*Amaurornis phoenicurus*	R	LC
	Order Charadriiformes			
	Family Recurvirostridae			
16	Black-winged Stilt	*Himantopus himantopus*	R	LC
	Family Charadriidae			
17	Red-wattled Lapwing	*Vanellus indicus*	R	LC
18	Little Ringed Plover	*Charadrius dubius*	R	LC
	Family Scolopacidae			
19	Common Sandpiper	*Actitis hypoleucos*	WV	LC
20	Green Sandpiper	*Tringa ochropus*	WV	LC
21	Temminck's Stint	*Calidris temminckii*	WV	LC
	Family Laridae			
22	River Tern	*Sterna aurantia*	R	NT
	Order Columbiformes			
	Family Columbidae			
23	Blue Rock Pigeon	*Columba livia*	R	LC
24	Eurasian Collared-dove	*Streptopelia decaocto*	R	LC
25	Western Spotted Dove	*Spilopelia suratensis*	R	LC
26	Laughing Dove	*Spilopelia senegalensis*	R	LC
	Order Psittaciformes			LC
	Family Psittacidae			
27	Rose-ringed Parakeet	*Psittacula krameri*	R	LC
28	Plum-headed Parakeet	*Psittacula cyanocephala*	R	LC
	Order Cuculiformes			
	Family Cuculidae			
29	Western Koel	*Eudynamys scolopaceus*	R	LC

Table 1: Avifauna recorded at Pipliyapala Regional Park (Indore region) during the study period (*contd*)

S. No.	Order/Family/Common Name	Scientific Name	Residential Status	IUCN Status (2017)
30	Greater Coucal	*Centropus sinensis*	R	LC
	Order Strigiformes			
	Family Strigidae			
31	Spotted Owlet	*Athene brama*	R	LC
	Order Caprimulgiformes			
	Family Apodidae			
32	Little Swift	*Apus affinis*	R	LC
	Order Coraciiformes			
	Family Alcedinidae			
33	White-breasted Kingfisher	*Halcyon smyrnensis*	R	LC
34	Common Kingfisher	*Alcedo atthis*	R	LC
35	Lesser Pied Kingfisher	*Ceryle rudis*	R	LC
	Family Meropidae			
36	Asian Green Bee-Eater	*Merops orientalis*	R	LC
	Order Bucerotiformes			
	Family Bucerotidae			
37	Indian Grey Hornbill	*Ocyceros birostris*	R	LC
	Order Piciformes			
	Family Megalaimidae			
38	Coppersmith Barbet	*Psilopogon haemacephalus*	R	LC
	Family Picidae			
39	Black-rumped Flameback	*Dinopium benghalense*	R	LC
	Order Passeriformes			
	Family Hirundinidae			
40	Dusky Crag-Martin	*Ptyonoprogne concolor*	R	LC
41	Barn Swallow	*Hirundo rustica*	WV	LC
42	Wire-tailed Swallow	*Hirundo smithii*	R	LC
	Family Oriolidae			
43	Indian Golden Oriole	*Oriolus kundoo*	R	LC
	Family Dicruridae			
44	Black Drongo	*Dicrurus macrocercus*	R	LC
	Family Sturnidae			
45	Brahminy Starling	*Sturnia pagodarum*	R	LC
46	Common Myna	*Acridotheres tristis*	R	LC
47	Asian Pied Starling	*Gracupica contra*	R	LC
	Family Corvidae			
48	Rufous Treepie	*Dendrocitta vagabunda*	R	LC
49	House Crow	*Corvus splendens*	R	LC
50	Large-billed Crow	*Corvus macrorhynchos*	R	LC
	Family Campephagidae			
51	Small Minivet	*Pericrocotus cinnamomeus*	R	LC
	Family Aegithinidae			
52	Common Iora	*Aegithina tiphia*	R	LC

Table 1: Avifauna recorded at Pipliyapala Regional Park (Indore region) during the study period (*contd*)

S. No.	Order/Family/Common Name	Scientific Name	Residential Status	IUCN Status (2017)
	Family Pycnonotidae			
53	Red-vented Bulbul	*Pycnonotus cafer*	R	LC
	Family Leiothrichidae			
54	Jungle Babbler	*Turdoides striata*	R	LC
	Family Muscicapidae			
55	Red-throated Flycatcher	*Ficedula albicilla*	WV	LC
56	Red-breasted Flycatcher	*Ficedula parva*	WV	LC
57	Brown Rockchat	*Oenanthe fusca*	R	LC
58	Oriental Magpie-robin	*Copsychus saularis*	R	LC
59	Black Redstart	*Phoenicurus ochruros*	WV	LC
60	Indian Robin	*Saxicoloides fulicatus*	R	LC
	Family Rhipiduridae			
61	White-spotted Fantail	*Rhipidura albogularis*	R	LC
	Family Cisticolidae			
62	Ashy Prinia	*Prinia socialis*	R	LC
63	Plain Prinia	*Prinia inornata*	R	LC
64	Common Tailorbird	*Orthotomus sutorius*	R	LC
	Family Acrocephalidae			
65	Booted Warbler	*Iduna caligata*	WV	LC
	Family Phylloscopidae			
66	Sulphur-bellied Warbler	*Phylloscopus griseolus*	WV	LC
67	Common Chiffchaff	*Phylloscopus collybita*	WV	LC
68	Greenish Warbler	*Phylloscopus trochiloides*	WV	LC
	Family Sylviidae			
69	Lesser Whitethroat	*Sylvia curruca*	WV	LC
	Family Dicaeidae			
70	Thick-billed Flowerpecker	*Dicaeum agile*	R	LC
71	Pale-billed Flowerpecker	*Dicaeum erythrorhynchos*	R	LC
	Family Nectariniidae			
72	Purple-rumped Sunbird	*Leptocoma zeylonica*	R	LC
73	Purple Sunbird	*Cinnyris asiaticus*	R	LC
	Family Zosteropidae			
74	Oriental White-eye	*Zosterops palpebrosus*	R	LC
	Family Passeridae			
75	House Sparrow	*Passer domesticus*	R	LC
	Family Estrildidae			
76	Indian Silverbill	*Euodice malabarica*	R	LC
	Family Motacillidae			
77	Western Yellow Wagtail	*Motacilla flava*	WV	LC
78	White Wagtail	*Motacilla alba*	WV	LC
79	White-browed Wagtail	*Motacilla maderaspatensis*	R	LC

Note: R - Resident, WV - Winter Visitor, LC - Least Concern, NT - Near Threatened

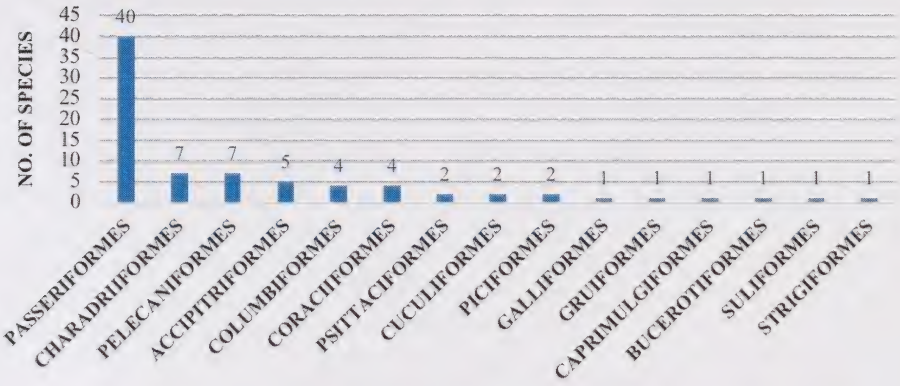

Fig. 1: Order wise percent contribution of the bird species found at Pipliyapala Regional Park

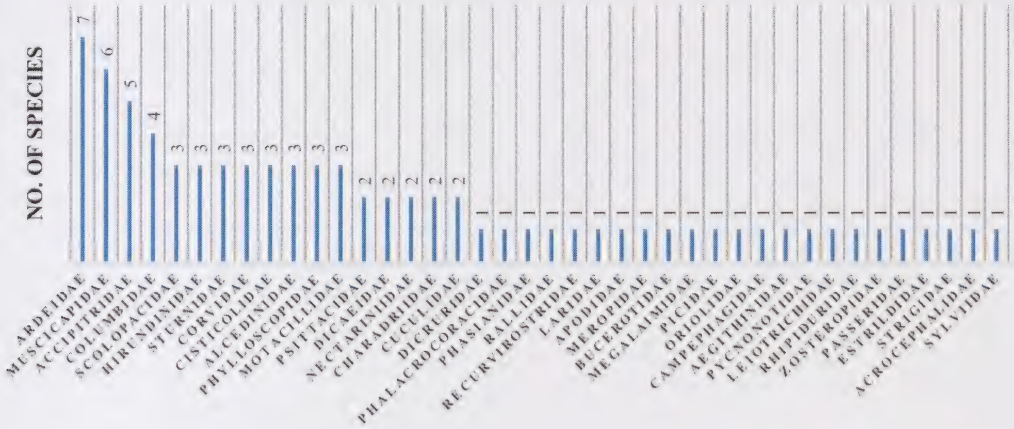

Fig. 2: Familywise percent contribution of bird species found at Pipliyapala Regional Park

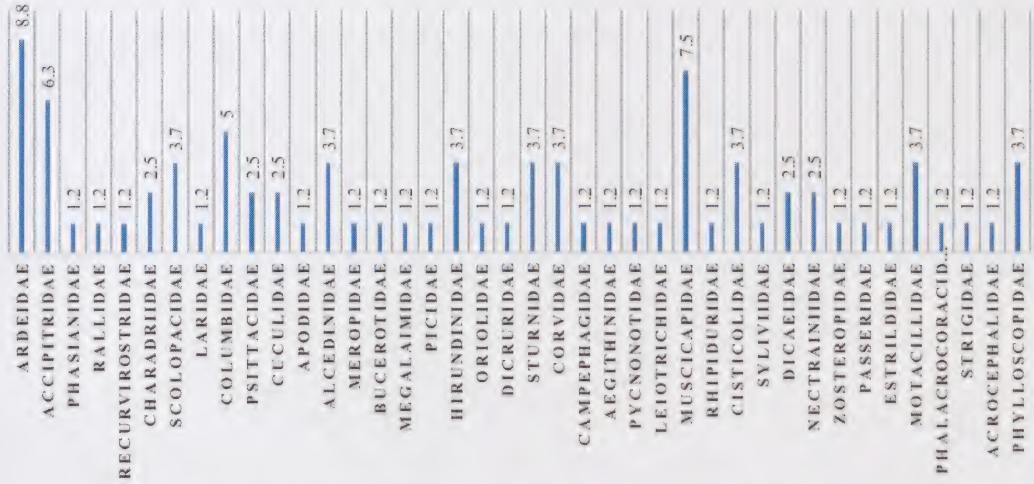

Fig. 3: Relative Diversity of Families found at Regional Park, Indore

Table 2: Avifauna recorded breeding at Pipliyapala Regional Park (Indore region)

S. No.	Bird Species	Breeding record based on	No. of nests/juv. recorded	Month
1.	Small Minivet *Pericrocotus cinnamomeus*	Nest	1	July-August
2.	Red-wattled Lapwing *Vanellus indicus*	,,	7	March-May
3.	Blue Rock Pigeon *Columba livia*	,,	2	All year
4.	Laughing Dove *Spilopelia senegalensis*	,,	1	March-May
5.	Coppersmith Barbet *Psilopogon haemacephalus*	,,	1	April-June
6.	Red-vented Bulbul *Pycnonotus cafer*	,,	2	March-May
7.	Purple Sunbird *Cinnyris asiaticus*	,,	2	March-May
8.	Dusky Crag Martin *Ptyonoprogne concolor*	,,	1	July
9.	Black Drongo *Dicrurus macrocercus*	,,	1	May-June
10.	House Crow *Corvus splendens*	,,	1	March-May
11.	House Sparrow *Passer domesticus*	,,	±3	March-June
12.	Oriental White-eye *Zosterops palpebrosus*	,,	1	July-August
13.	Common Iora *Aegithina tiphia*	,,	1	July-August
14.	Rose-ringed Parakeet *Psittacula krameri*	,,	1	May-June
15.	Oriental Magpie-robin *Copsychus saularis*	,,	1	May-June
16.	Indian Robin *Saxicoloides fulicatus*	Juveniles	3	May
17.	Ashy Prinia *Prinia socialis*	,,	3	September
18.	Common Myna *Acridotheres tristis*	,,	2	July
19.	Western Spotted Dove *Spilopelia suratensis*	Bird carrying nesting material	--	May
20.	Common Tailorbird *Orthotomus sutorius*	,,	--	July
21.	Brown Rockchat *Oenanthe fusca*	Parent birds carrying food material	--	July

al. (2015). The number of migratory birds, threatened birds, and the number of breeding species are the chief indicators of the good health of any environment (Koskimies 1989). Hence, the breeding of 21 species and presence of threatened species in the Park indicates its good health.

The Order Passeriformes was found to be dominant with 40 species in the present study (Table 1, Fig. 1), which is also reported earlier (Bagde 2015; Joshi and Shrivastava 2012; Prakash *et al.* 2004; Rawal *et al.* 2016; Sharma and Shukla 2015). In the present study at the selected site, Family Ardeidae was found to be rich with 7 species (Table 1, Fig. 2) and has the highest relative diversity (RD) index (RD value=8.8) as shown in Fig. 3.

Red-vented Bulbul, Blue Rock Pigeon, Little Egret, Ashy Prinia, Indian Pond-Heron, Laughing Dove, Purple Sunbird, Jungle Babbler, Coppersmith Barbet, and Red-wattled Lapwing were found to be the most common birds during the present study, as reported in earlier studies (Aggarwal *et al.* 2015; Datta 2016; Sharma and Shukla 2015; Tiple *et al.* 2010). On the other hand, River Tern, Great Cormorant, Black-shouldered Kite, and Purple Heron were recorded only a few times (Chandra *et al.* 2015; Datta 2016; Tiple *et al.* 2010). Birds like Asian Pied Starling, House Sparrow, and Indian Silverbill were recorded only from undisturbed grassland areas of the Pipliyapala Regional Park, as seen by Vyas and Singh (2004). Similarly, Indian Peafowl was recorded only from shady bushy areas where human entrance was not allowed, showing their preference for undisturbed areas as earlier described by Mengesha *et al.* (2011).

Some of the resident birds were recorded only in specific seasons, suggesting their local movements (Garg *et al.* 2013; Jain *et al.* 2015). Great Cormorant was seen only during winter at Pipliyapala Regional Park during the study period, which suggests that this species could be a winter visitor to the site. Such winter migratory aspects of Great Cormorants were also noted by earlier workers (Chandra *et al.* 2015; Garg *et al.* 2013; Jain *et al.* 2015). Similarly, Large Egret was only recorded in the rainy and winter seasons, Purple Heron only in the rainy season and Grey Heron in the summer season at the study sites, suggesting that they are local migrants, which was also described earlier (Garg *et al.* 2013; Jain *et al.* 2015; Pasha *et al.* 2004; Sharma and Shukla 2015; Tiple *et al.* 2010). Bopinwar *et al.* (2012) consider the Little Ringed Plover as a widespread winter visitor, as also suggested by the study. Our observation of Cattle Egret during the rainy season, which showed a gradual decrease in its frequency at the Park, correlates well with prior observations by Joshi and Shrivastava (2012). The present work shows a decrease in the frequency of Rose-ringed Parakeet during

Table 3: Nesting site, nesting material and nest type of breeding species recorded
(Only species whose breeding was recorded based on the presence of nest are included in this list)

S. No.	Name of Bird	Nesting Site	Nesting Materials	Nest Type
1.	House Crow *Corvus splendens*	Silk Cotton tree *Bombax ceiba*	Sticks, twigs	Platform nest
2.	Blue Rock Pigeon *Columba livia*	Wall hole, Under bridge	Small sticks	,,
3.	Laughing Dove *Spilopelia senegalensis*	Bidi Leaf tree *Bauhinia racemosa*	Small sticks, twigs, grass	,,
4.	Rose-ringed Parakeet *Psittacula krameri*	Silk Cotton tree *Bombax ceiba*	--	Hole nest
5.	Coppersmith Barbet *Psilopogon haemacephalus*	Silk Cotton tree *Bombax ceiba*	--	,,
6.	Oriental Magpie-robin *Copsychus saularis*	Silk Cotton tree *Bombax ceiba* cavity	Grass, twigs, fibre	,,
7.	House Sparrow *Passer domesticus*	Holes in canal wall	Grass, twigs, fibre	,,
8.	Red-vented Bulbul *Pycnonotus cafer*	Benjamin Ficus *Ficus benjamina*	Grass, fibres, cobweb	Cup nest
9.	Small Minivet *Pericrocotus cinnamomeus*	Indian Coral tree *Erythrina variegata*	,,	,,
10.	Oriental White-eye *Zosterops palpebrosus*	Gulmohar *Delonix regia*	,,	,,
11.	Common Iora *Aegithina tiphia*	Benjamin Ficus *Ficus benjamina*	,,	,,
12.	Black Drongo *Dicrurus macrocercus*	Kadam tree *Neolamarckia cadamba*		,,
13.	Dusky Crag Martin *Ptyonoprogne concolor*	Vertical face of wall	Mud	Half cup nest
14.	Purple Sunbird *Cinnyris asiaticus*	Babul tree *Vachellia nilotica*	Grass, fibres, cobweb, leaves	Pendant nest
15.	Red-wattled Lapwing *Vanellus indicus*	Open bare ground	Lined with small pebbles	Ground nest

the winter season, which correlates with similar findings by Aggarwal *et al.* (2015). In contrast to the study by Joshi and Shrivastava (2012), which described Brahminy Starling as resident-migratory, the present study showed that it prefers to stay at the site during winters and spring, and is absent during other seasons. Again, similar to prior studies (Pasha *et al.* 2004; Prakash and Saxena 2005; Saxena *et al.* 2007; Talmale *et al.* 2012), which designated the Black-winged Stilt as locally migratory, the present observations did not record the Black-winged Stilt during summer at Pipliyapala Regional Park, suggesting its local movement.

Bonelli's Eagle, which has been recorded at only a few places in Madhya Pradesh state (Kushwaha *et al.* 2015; Nair and Krishna 2013; Pasha *et al.* 2004), was recorded for the first time in Indore city in our study. Present observations also suggested that the number of waders at Pipliyapala Lake region increased during the winter, with decrease in water level, which exposed large portions of submerged land and provided feeding ground for these birds. This study can be correlated to some extent with the prior observation by Vyas and Singh (2004).

It was observed that the number of species decreased during the summer season at the Park, which has a permanent water source (Fig. 4). The reason behind this decrease is the presence of short trees which shed leaves during summer, providing less shade for the birds. This forces birds to locally move from the Park during summer. Hence, the presence of large trees with dense foliage is also crucial for the birds to thrive during hot sunny days, along with other resources.

Local children were seen catching chicks of Red-wattled Lapwing for unknown reasons. Similar observations of hunting of aquatic birds were made at Sirpur tank, Indore (Garg *et al.* 2013; Jain *et al.* 2015). Occasional attacks on Red-wattled Lapwing chicks by stray dogs were seen at the Park, and dogs were also seen chasing aquatic birds. According to Banks and Bryant (2007), these stray dogs were a threat to the birds.

CONCLUSION

This study entails identification, breeding, and seasonal variation of the avian fauna and also a thorough review of

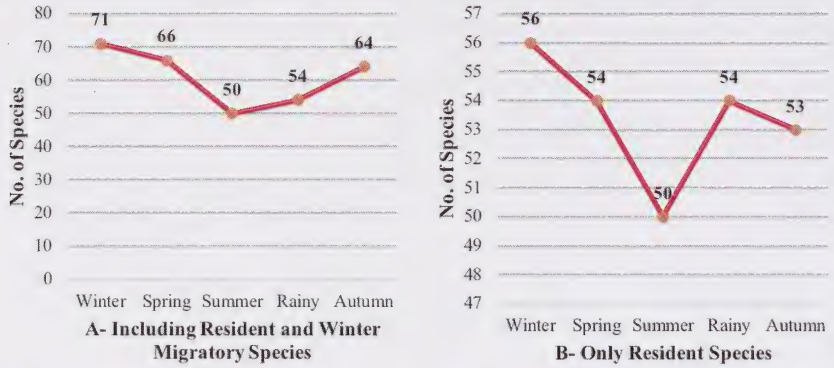

Fig. 4: Seasonal variation of avian fauna (A- Resident and Migratory species, B- Only Resident species

relevant literature. As per the study, the Park was found to support 79 species of birds in different seasons. This is the first ever comprehensive checklist of birds (resident and migratory species) at Pipliyapala Regional Park. A permanent recreational water source at the park supports a large number of aquatic and terrestrial birds, including many migratory species such as Common Sandpiper, Green Sandpiper, Little Ringed Plover, Purple Heron, and uncommon species such as River Tern (which is now Near Threatened), thus reflecting the importance of artificial manmade urban water reservoirs. The study site serves as a breeding ground for 21 species of birds (recorded for the first time) (Table 2), which reflects its good ecology, as breeding is a strong bio-indicator for the health of any environment. The Park providing an important breeding place and permanent residence to the declining house sparrow population serves as a perfect example, and this may be true for similar conservation of many other bird species. Urban habitats were also seen to have a negative impact on bird existence, in the form of unwanted human interference and menace of stray animals, which are threats to bird survival and sustenance, and need immediate attention. Based on the current study, it can be concluded that the Park has good ecological conditions. However, proper maintenance of gardens and some enrichment is required to conserve its inhabitants.

ACKNOWLEDGEMENTS

The authors are grateful to Dr M.M.P Shrivastava, Professor and Head of the Dept of Zoology, Govt (Model, Autonomous) Holkar Science College, Indore, Madhya Pradesh, for his immense support and guidance in the completion of the research. We express our sincere thanks to the honorable Principal, Govt Holkar Science College, Indore, for providing facilities and granting us permission to carry out research work.

REFERENCES

Aggarwal, A., G. Tiwari & S. Harsh (2015): Avian diversity and density estimation of birds of the Indian Institute of Forest Management Campus, Bhopal, India. *Journal of Threatened Taxa 7(2)*: 6891–6902.

Ali, Sálim (2002): The Book of Indian Birds. Revised and enlarged 13th edn. Bombay Natural History Society, Mumbai.

Bagde, N. (2015): Avian diversity and its conservation in West Chhindwara Region of Madhya Pradesh, India. *International Journal of Life Sciences 3(3)*: 210–218.

Banks, P.B. & J.V. Bryant (2007): Four-legged friend or foe? Dog walking displaces native birds from natural area. *Biology Letters 3*: 611–613.

Basavarajappa, S. (2006): Avifauna of agro ecosystem of Maidan area of Karnataka. *Zoo's Print 21(4)*: 2217–2219.

Bibby, C.J., N.D. Burgess & D.A. Hill (2012): Bird Census Techniques. Academic Press, London. Pp. 120–121.

BirdLife International (2016): *Sterna aurantia*. The IUCN Red List of Threatened Species. Version 2016-3. Available from http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22694537A93456605.en. Accessed on April 04, 2017.

Bonier, F., P.R. Martin & J.C. Wingfield (2007): Urban birds have broader environmental tolerance. *Biology Letters 3*: 670–673.

Bopinwar, S., S.B. Zade & T.K. Ghosh (2012): Seasonal movements and migration of birds: Indian scenario. *Journal of Today's Biological Sciences: Research & Review (JTBSRR) 1(1)*: 103–121.

Chandra, K., S.K. Dutta, R.P. Gupta & A. Raha (2015): Diversity and conservational status of avifauna in Bastar Plateau of Chhattisgarh, India. *Ambient Science 2(1)*: 31–43.

Datta, M. (2016): Status, guild and diversity of avian fauna from a wetland site and surroundings, in Krishnanagar, a city beside Tropic of Cancer, West Bengal, India. *International Journal of Fauna and Biological Studies 3(4)*: 68–75.

Davies, R.G., O. Barbosa, R.A. Fuller, J. Tratalos, N. Burke, D. Lewis, P.H. Warren & K.J. Gaston (2008): City-wide relationships between green spaces, urban land use and topography. *Urban Ecosyst. 11*: 269–287.

FULLER, R.A., P.H. WARREN & K.J. GASTON (2007): Daytime noise predicts nocturnal singing in urban robins. *Biology Letters 3*: 368–370.

GARG, R.K., R.J. RAO & D.N. SAKSENA (2013): Spatial relations of migratory birds and water quality management of Ramsagar reservoir, Datia, Madhya Pradesh, India. *Journal of Ecology and the Natural Environment 5(10)*: 335–339.

GREWAL, B., S. SEN, S. SINGH, N. DEVASAR & G. BHATIA (2016): A Pictorial Field Guide to Birds of India. Om Books International, Noida.

GRIMMETT, R., C. INSKIPP & T. INSKIPP (2011): Birds of the Indian Subcontinent. 2nd edn. Oxford University Press, London.

HBW & BIRDLIFE INTERNATIONAL (2017): Handbook of the Birds of the World and BirdLife International digital checklist of the birds of the world. Version 2. Available from http://datazone.birdlife.org/userfiles/file/Species/Taxonomy/HBW-BirdLife_Checklist_Version_2.zip[.xlszipped1MB]. Accessed on October 20, 2018.

JAIN, A., L.K. MUDGAL & G.D. SHARMA (2015): Spatial relations of migratory birds and water quality management of Sirpur Lake, Indore, Madhya Pradesh. *International Journal of Scientific Research and Education 3(7)*: 4091–4096.

JAIN, N.K., S.N. PATEL & M.V. PATEL (2005): Birds of Gujarat University Campus, Ahmedabad. *Zoo's Print Journal 20(12)*: 2111–2113.

JOSHI, P. & V.K. SHRIVASTAVA (2012): Ecological study and bird diversity of Tawa Reservoir and its surrounding areas of Hoshangabad district (Madhya Pradesh). *The Bioscan: An International Quarterly Journal of Life Sciences 7(1)*: 129–133.

KOSKIMIES, P. (1989): Birds as a tool in environmental monitoring. *Ann. Zool. Fennici. 26*: 153–166.

KUSHWAHA, S., A. KANAUJIA, A. KUMAR, A. KUMAR & S. Maheshwari (2015): Avifaunal diversity of Tikamgarh District, Madhya Pradesh, India. *Discovery Nature 9(20)*: 20–32.

MENGESHA, G., Y. MAMO & A. BEKELE (2011): A comparison of terrestrial bird community structure in the undisturbed and disturbed areas of the Abijata Shalla Lakes National Park, Ethiopia. *International Journal of Biodiversity and Conservation 3(9)*: 389–404.

MENON, M., P. DEVI & R. MOHANRAJ (2012): Functional assemblages of birds in heterogeneous landscapes along an urban-rural gradient in Tiruchirappalli, India. *J. Bombay Nat. Hist. Soc. 109(1&2)*: 23–29.

NAIR, T. & Y.C. KRISHNA (2013): Vertebrate fauna of the Chambal River Basin with emphasis on the National Chambal Sanctuary, India. *Journal of Threatened Taxa 5(2)*: 3620–3641.

PASHA, M.K.S., R. JAYPAL, G. AREENDRAN, Q. QURESHI & K. SANKAR (2004): Birds of Pench Tiger Reserve, Madhya Pradesh, Central India. *Newsletter for Ornithologists 1(1–2)*: 2–3.

PRAKASH, M.M. & G. SAXENA (2005): Population Dynamics of Waterfowl at Krishnapura Talab, Indore (M.P.). *National Journal of Life Sciences 2(1&2)*: 45–48.

PRAKASH, M.M., K. PANWAR, M. MALHOTRA, V.K. SHARMA, P. KASKHEDIKAR, A. SHARMA & N.K. DHAKAD (2004): Birds of Holkar Science College Campus, Indore. *Troiectory 12(1)*: 59–63.

RAWAL, R., S. GAHERWAL & N. WAST (2016): Avian diversity in and around Kunda reservoir, (District-Dhar). *International Journal of Advanced Research 4(1)*: 690–695.

SANDSTRÖM, U.G., P. ANGELSTAM & G. MIKUSINSKI (2006): Ecological diversity of birds in relation to the structure of urban green space. *Landscape and Urban Planning 77(1–2)*: 39–53.

SAXENA, G.S., M.M. PRAKASH & B. ARORA (2007): Aquatic birds diversity at Yashwant Nagar Talaab, Mhow (M.P.). *Environment Conservation Journal 8(3)*: 39–45.

SERESS, G. & A. LIKER (2015): Habitat urbanization and its effects on birds. *Acta Zoologica Academiae Scientiarum Hungaricae 61(4)*: 373–408.

SHARMA, S. & A. SHUKLA (2015): Preliminary study on avian faunal diversity of Polipathar area in Jabalpur (M.P.). *International Journal of Current Advanced Research 4(9)*: 364–367.

SHOCHAT, E., S. LERMAN & E. FERNÁNDEZ-JURICIC (2010): Birds in Urban Ecosystems: Population Dynamics, Community Structure, Biodiversity and Conservation. *In*: Urban Ecosystem Ecology, Agron. Monogr. 55. ASA, CSSA, SSSA, Madison, WI. pp. 75–86.

SILVA, C.P., C.E. GARCIA, S.A. ESTAY & O. BARBOSA (2015): Bird richness and abundance in response to urban form in a Latin American City: Valdivia, Chile as a case study. *PLoS ONE 10(9)*: 1–16.

TALMALE, S.S., M.E. LIMJE & S. SAMBATH (2012): Avian diversity of Singhori Wildlife Sanctuary, Raisen district, Madhya Pradesh. *Biological Forum – An International Journal 4(2)*: 52–61.

TIPLE, A.D., N. KULKARNI, S. PAUNIKAR & K.C. JOSHI (2010): Avifauna of Tropical Forest Research Institute Campus, Jabalpur, Madhya Pradesh, India. *Indian J. Trop. Biodiv. 18(1)*: 133–141.

VISHWAKARMA, A., A. HEMROM & K.C. YADAV (2014): Status of terrestrial and wetland birds in Karwadha, Kabirdham district in Chhattisgarh, India. *International Journal of Scientific and Research Publications 4(10)*: 1–7.

VYAS, R. & H. SINGH (2004): Biodiversity Survey of Gandhi-Sagar Reservoir, Madhya Pradesh, *Zoo's Print Journal 19(7)*: 1525–1529.

Recommended Citation

Bhonsle, Osho, Chandra Shekhar Shrivastava, Renu Jain and Santosh Gaherwal (2019): A study on avian fauna at Pipliyapala Regional Park, Indore, Madhya Pradesh, India. *J. Bombay Nat. Hist. Soc.* Vol. *116*: 46–55. doi: 10.17087/jbnhs/2019/v116/129405

PHYLOGENETIC DIVERSITY AS A MEASURE OF BIODIVERSITY: PROS AND CONS[1]

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[1]Accepted March 20, 2019
First published: August 30, 2019 | doi: 10.17087/jbnhs/2019/v116/120848
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Species richness is predominantly used as one of the fundamental measures of biodiversity for prioritization of areas for conservation. However, species richness often underestimates true diversity, as it does not take into account the evolutionary histories of the species in an area. In this regard, phylogenetic diversity, which incorporates information regarding species relationships in calculating diversity, has been proposed as an alternative. Here we compare species richness and phylogenetic diversity of mammals in nine sanctuaries to explore the importance and use of evolutionary relationships in characterizing diversity. Our analyses suggest that even though species richness and phylogenetic diversity are correlated, they are often decoupled. Importantly, areas with low species richness might harbour high phylogenetic diversity and viceversa. We recommend the use of both the diversity measures for a holistic understanding of biodiversity and for prioritization of areas for conservation.

Key words: Molecular phylogeny, species richness, conservation, mammals, sanctuaries, genetic diversity

INTRODUCTION

Species richness, a widely used measure of diversity, is one of the important attributes used for prioritizing areas for conservation (Caldecott 1996; Kerr 1997). The ease with which it can be calculated makes it attractive, and furthermore, it conveys the message to a non-scientific audience in the form of a simple number. Species richness (SR) is simply the number of species of a particular taxonomic group in an area. Not surprisingly, SR has been used extensively to identify priority areas for conservation on both local (Freemark *et al.* 2006; Gerlach 2008; Maes *et al.* 2005; Médail and Quézel 1999; Villalobos *et al.* 2013) and global scales (Brooks *et al.* 2006; Myers *et al.* 2000). However, species richness does not give us a complete picture regarding the diversity of an area. It tells us how many different species inhabit an area, but does not provide any information on how different these species are from each other. Thus, it treats all species as taxonomically equivalent (Vane-Wright *et al.* 1991). A critical piece of information, i.e., evolutionary relationships between species, is not included in this measure of diversity. For example, an area with four species of lizards (skink, gecko, chameleon, and garden lizard) and another area with four species of reptiles (gecko, cobra, crocodile, and tortoise) will both be assigned the same value for reptile richness. Nevertheless, the latter has greater diversity as it harbours a relatively diverse composition of reptiles. Thus, species richness often underestimates true diversity, as it does not take into account the evolutionary histories of the species in an area.

To correct this discrepancy, diversity can be measured at higher levels, i.e., richness at the level of genus or family or order. In the two cases discussed above, the former is represented by only one order (Squamata), whereas the latter has three orders (Crocodilia, Testudines, and Squamata). Yet this approach too has its limitations, due to discordance between taxonomic rank and age of the taxonomic group. For example, mammals and insects are assigned the same taxonomic rank (classes Mammalia and Insecta), but modern mammals as a group evolved relatively recently, around 65 million years ago (mya) compared to insects (around 300 mya). Thus, two distantly related insects encompass greater evolutionary history than two distantly related mammals. Furthermore, taxonomic uncertainties in certain problematic groups can also generate erroneous values for richness at higher levels. For example, among the langurs of the Indian subcontinent, Nilgiri and Purple-faced langurs have been assigned to various genera (*Kasi*, *Trachypithecus*, and *Semnopithecus*), whereas Hanuman langurs are placed in the genus *Semnopithecus*. Thus, the genus level primate richness of an area with both Hanuman and Nilgiri langurs will vary from one to two depending on the classification scheme being followed (see Karanth *et al.* 2008).

To address some of these issues, Vane-Wright *et al.* (1991) came up with a new diversity measure called "taxic diversity", that was later developed into "phylogenetic

diversity" by Faith (1992). In the broad sense, phylogenetic diversity (PD) is the sum of branch lengths in a phylogenetic tree of species from a given area. More specifically, according to Faith (1992), "The phylogenetic diversity of *s* is equal to the sum of the lengths of all those branches that are members of the corresponding minimum spanning path," where *s* is the subset of taxa recorded from that area (species richness). It is a measure of biodiversity that takes into consideration evolutionary histories of species in an area by incorporating information regarding their relationships in calculating diversity (Rodrigues and Gaston 2002). The use of PD is illustrated in a hypothetical example shown in Fig. 1. In this example, we consider four areas (1–4) with identical species richness (3 species each). Together these four areas harbour six species (species A, B, C, D, E, and F). The phylogeny in Fig. 1 shows the relationships between these species.

The branch lengths in the phylogeny correspond to number of changes along each lineage. Thus, species D and E are distantly related, i.e., exhibit higher genetic distance between them (11 units) when compared to species A and B which are closely related (2 units). In the case of area 1, the PD is given by the sum of the branches connecting species A, B, and C (1.0 + 1.0 + 1.5 + 0.5) as well as the branch leading to the root from the common ancestor of A, B, and C (3+1), giving a total of 8 (Fig. 2). Similarly, the PD of areas 2, 3, and 4 are 11.5, 15.5, and 12, respectively. Clearly, even though the SR of these three areas is the same, their PD is very different, with area 3 having the highest diversity. In area 1, which has the lowest PD, the species are closely related (phylogenetically clumped/similar), whereas in area 3 the species are phylogenetically dispersed/diverse.

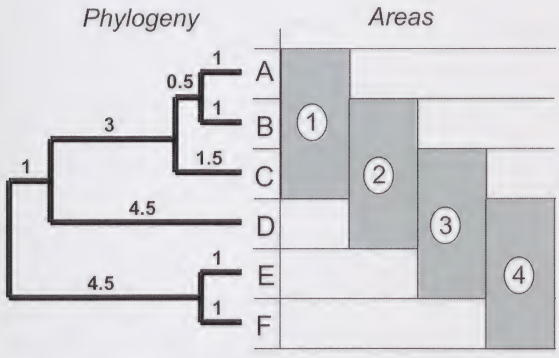

Fig. 1: A hypothetical phylogeny showing the relationships between species A–F. To the right of the phylogeny are the areas (1–4) where these species are distributed. For example, area 1 harbours species A, B, and C. Number on the phylogeny represents changes along each lineage

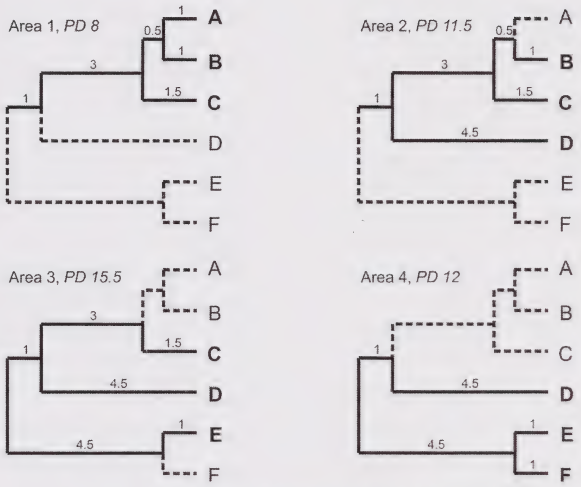

Fig. 2: Phylogenetic diversity (PD) of areas 1–4. Lineages leading to species present in an area are coloured black and those not in an area are in grey.

Including phylogenetic information has introduced a new dimension to the diversity measure, i.e., evolutionary history of the taxa under consideration. This significant component of diversity is not captured by traditional diversity measures such as Species Richness (SR). More importantly, SR might underestimate true diversity.

The examples discussed above are hypothetical, and therefore the relationship between SR and PD needs to be explored with empirical data. Interestingly, many studies have reported a positive correlation between SR and PD (Cadotte *et al.* 2010; Polasky *et al.* 2001). Thus, some authors have argued that SR can be used as a surrogate for PD (Bertrand *et al.* 2006; Crozier 1997; Pérez-Losada and Crandall 2003). The correlation between SR and PD is not surprising, because as one adds more taxa to a phylogeny (more branches), the sum of branch lengths, and therefore PD, is bound to increase (Schweiger *et al.* 2008). Nevertheless, others have reported that this relationship is not as straightforward as previously thought, and often there is a mismatch between these diversity measures (Rodrigues and Gaston 2002). More importantly, studies also suggest that the use of both SR and PD can reveal some interesting hidden patterns (Forest *et al.* 2007; Safi *et al.* 2011).

In this regard, the Indian subcontinent provides an interesting setting to explore these issues. This is because India is one of the megadiversity countries (Mittermeier 1997) with multiple biodiversity hotspots (Myers *et al.* 2000). Additionally, the origin and affinity of its biota is complex, comprising older Gondwana elements and more recent intrusive elements from Asia and Africa (Datta-Roy and Karanth 2009). Till date, there have been no publications from India that have examined PD of various Indian regions.

In this paper, we explore the usefulness of PD in conservation biology by comparing SR and PD of mammals across nine sanctuaries in India, spanning different bioclimatic and zoogeographical zones.

MATERIAL AND METHODS

Mammalian SR and PD across sanctuaries in India

Nine sanctuaries were selected from across India, spanning a wide range of habitats and topographical features. These included Dachigam and Corbett from northern India, Gir and Ranthambore from western India, Bandipur and Anaimalai from southern India, Kanha from central India, and Namdapha and Kaziranga from eastern India. For each sanctuary, a list of reported mammals was prepared, and this list served as the mammalian SR (See Table 1). Information for the list was sourced from researchers, online checklists, and guide books. Some mammalian groups were excluded, as authentic information regarding their diversity in most sanctuaries was lacking. The excluded groups were rodents, bats, and small carnivores (small cats and viverrids). These lists were merged and gave a grand total of 51 species across the nine sanctuaries, representing the orders Artiodactyla, Carnivora (excluding small cats and viverrids), Perissodactyla, Primates, and Proboscidea. The mitochondrial Cytochrome *b* (Cyt*b*) sequences for these species were downloaded from GenBank® and aligned using MEGA 5.2 (Tamura *et al.* 2011). After alignment, only the common overlapping regions of 271 bp were used for further analysis. Firstly, a master tree was generated for the 51 species based on known

Table 1: Mammalian SR for nine sanctuaries studied across India

MAMMALS	Accession No.	Nd	A	B	C	D	G	Kh	Kzi	Rb
Order Primates										
PROSIMIANS (LORIDAE)										
Slow Loris *Nycticebus bengalensis*	KC977312	1							1	
Slender Loris *Loris lyddekerianus*	KC757402		1	1						
MONKEYS (CERCOPITHECIDAE)										
Rhesus Macaque *Macaca mulatta*	JQ821843	1			1	1	1	1	1	1
Bonnet Macaque *Macaca radiata*	DQ859974		1	1						
Assamese Macaque *Macaca assamensis*	AY685863	1								
Pig-tailed Macaque *Macaca leonina*	AF350398	1							1	
Stump-tailed Macaque *Macaca arctoides*	AY685833	1							1	
Milne-Edwards' Macaque *Macaca thibetana*	AY563620								1	
Lion-tailed Macaque *Macaca silenus*	AF350403		1							
Nilgiri Langur *Semnopithecus johnii*	HQ149050		1							
Capped Langur *Trachypithecus pileatus*	AF294626	1							1	
Hanuman Langur *Semnopithecus entellus*	EU004478		1	1	1	1	1	1		1
GIBBON (HYLOBATIDAE)										
Western Hoolock Gibbon *Hoolock hoolock*	GU321289	1							1	
Order Artiodactyla										
MOSCHIDAE										
Himalayan Musk Deer *Moschus chrysogaster*	JQ608470				1	1				
CERVIDAE										
Sambar *Rusa unicolor*	KX156946	1	1	1			1	1	1	1
Tarim Red Deer *Cervus hanglu*	AB001612					1				
Barasingha *Rucervus duvaucelii*	AY607041							1	1	
Northern Red Muntjac *Muntiacus vaginalis*	AY225986	1	1	1	1			1	1	1
Hog Deer *Axis porcinus*	AY035874	1			1				1	
Chital *Axis axis*	AY607040		1	1	1		1	1		1
TRAGULIDAE										
Indian Chevrotain *Moschiola indica*	DQ676954		1					1		

Table 1: Mammalian SR for nine sanctuaries studied across India (contd)

MAMMALS	Accession No.	Nd	A	B	C	D	G	Kh	Kzi	Rb
BOVIDAE										
Nilgai *Boselaphus tragocamelus*	EF536350				1		1	1		1
Blackbuck *Antilope cervicapra*	AP003422									1
Four-horned Antelope *Tetracerus quadricornis*	AF036274		1	1			1	1		
Indian Gazelle *Gazella bennettii*	JN632635						1			1
Takin *Budorcas taxicolor*	AY669320	1								
Himalayan Serow *Capricornis thar*	DQ459334	1			1	1				
Red Goral *Naemorhedus baileyi*	JX506310	1								
Himalayan Goral *Naemorhedus goral*	EU259118				1					
Himalayan Tahr *Hemitragus jemlahicus*	FJ207531				1	1				
Nilgiri Tahr *Hemitragus hylocrius*	AY846792		1							
Wild Water Buffalo *Bubalus arnee*	FJ467729								1	
Gaur *Bos gaurus*	JN632604	1	1	1	1			1	1	
SUIDAE										
Wild Pig *Sus scrofa*	JN406900	1	1	1	1		1	1	1	1
Order Proboscidea										
ELEPHANTIDAE										
Asian Elephant *Elephas maximus*	D50846		1	1	1				1	
Order Perissodactyla										
RHINOCEROTIDAE										
Indian Rhinoceros *Rhinoceros unicornis*	JF718877								1	
Order Carnivora										
URSIDAE										
Red Panda *Ailurus fulgens*	X94919	1								
Brown Bear *Ursus arctos*	AF303110					1				
Asian Black Bear *Ursus thibetanus*	AB360957	1			1	1				
Sun Bear *Helarctos malayanus*	HMU18899	1								
Sloth Bear *Melursus ursinus*	MUU23560		1	1	1	1		1	1	1
CANIDAE										
Golden Jackal *Canis aureus*	AY291433	1	1	1	1	1	1	1	1	1
Wolf *Canis lupus*	AB499825						1	1		
Dhole *Cuon alpinus*	GU063864	1	1	1	1			1		
Red Fox *Vulpes vulpes*	EF689061				1	1	1			1
HYAENIDAE										
Striped Hyena *Hyaena hyaena*	AY928678						1	1		1
FELIDAE										
Tiger *Panthera tigris*	EF551003	1	1	1	1			1	1	1
Asiatic Lion *Panthera leo*	AY781206						1			
Leopard *Panthera pardus*	EF551002		1	1	1	1	1	1	1	1
Snow Leopard *Uncia uncia*	EF551004					1				
Clouded Leopard *Neofelis nebulosa*	DQ257669	1								
Species richness (SR)		22	19	15	20	13	14	18	20	15
Faith's Phylogenetic Diversity (FPD)		1034.92	1048.82	824.84	1002.24	749.56	799.64	899.66	1074.24	849.18

Note: A – Anaimalai; B – Bandipur; C – Corbett; D – Dachigam; G – Gir; Kh – Kanha; Kz– Kaziranga; Nd – Namdapha; Rb – Ranthambore

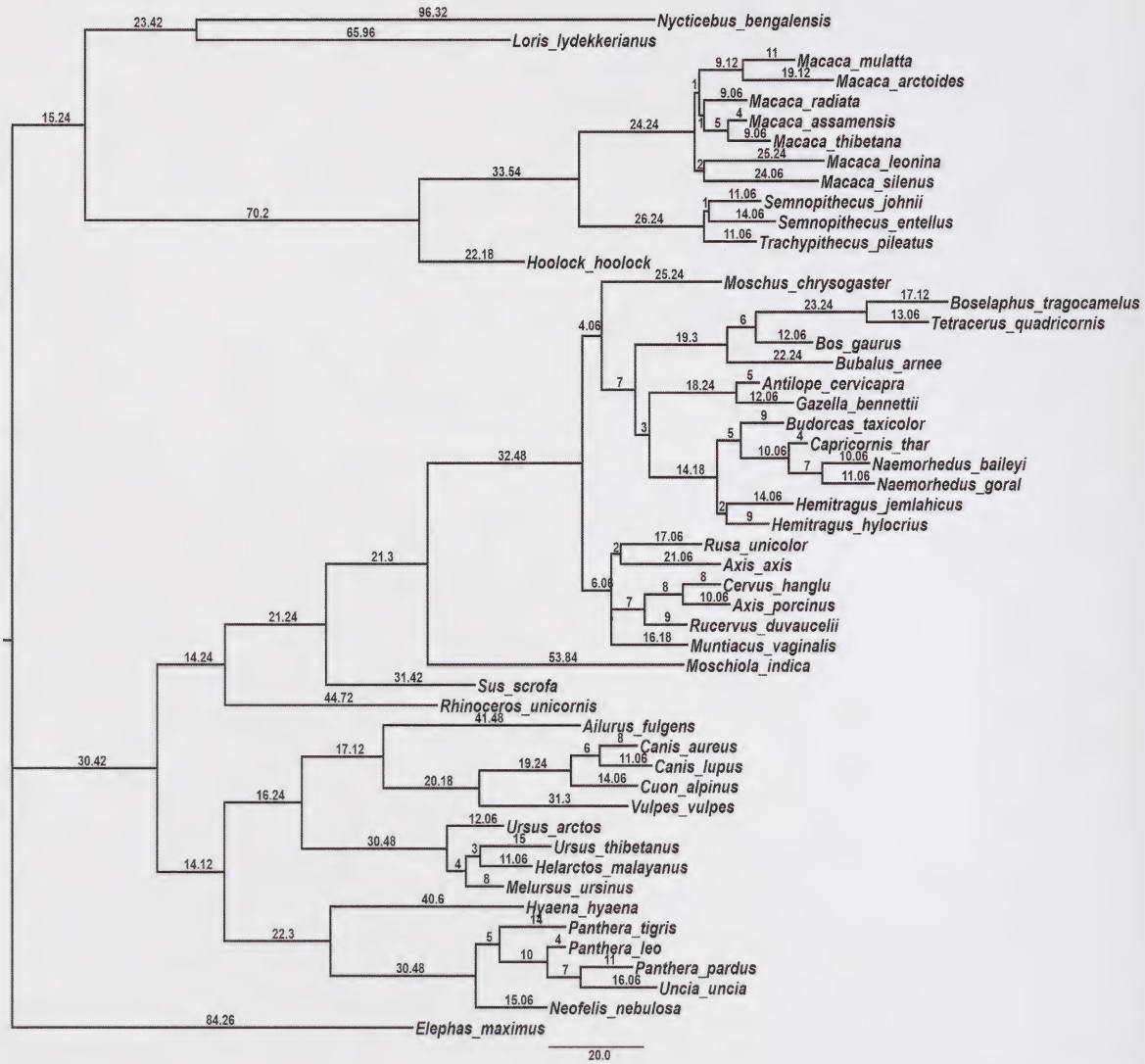

Fig. 3: Master Tree for 51 species based on known mammalian phylogeny

mammalian phylogeny. This phylogeny in conjunction with the Cyt*b* alignment was used to infer branch length in PAUP (Swofford 2003). For branch length estimation parsimony criteria were used with 3:1 transition-transversion weighting scheme. The phylogeny was rooted using Proboscidea as the outgroup (See Fig. 3).

Three different PD analyses were undertaken. Firstly, Faith's PD (FPD) for each sanctuary was calculated from the phylogram using the minimum spanning path method (Faith 1992). Faith's PD does not correct SR and is, therefore, not a good index for studying decoupling between PD and SR. To address this issue we also used an averaging index to calculate PD, namely Mean Phylogenetic Distance or MPD (Izsák and Papp 2000). MPD corrects for SR and calculates PD as an average distance measure. Decoupling PD from SR can be further studied by using a null distribution of expected MPD value for a given number of species, and determining if the observed MPD is more (positive) or less (negative) than expected. This index, called MPD-ses (Standardized Effect Size), is reported in terms of the number of standard deviations that the observed MPD deviates from the mean of the null distribution (Kembel 2009). Both MPD and MPD-ses were calculated for each sanctuary, using R (R Core Team 2015) on RStudio (RStudio Team 2015) using functions from packages APE (Paradis *et al.* 2004), GEIGER (Harmon *et al.* 2008), and Picante (Kembel *et al.* 2010).

RESULTS AND DISCUSSION

Mammalian richness ranged from 13 to 22, with Dachigam harbouring lowest and Namdapha the highest mammalian SR in our dataset. FPD (Faith's PD) ranged from 792 to 1,077, with Dachigam exhibiting the lowest FPD; however, both Kaziranga and Namdapha showed comparable highest FPD. Overall there was a positive correlation between SR and PD (Fig. 4), suggesting that FPD increases with increase in SR.

In Fig. 5, the same data has been presented with SR and FPD for each sanctuary plotted together and compared across sanctuaries.

This comparison revealed interesting patterns which are depicted as different scenarios in Table 2. For most pairwise comparisons of sanctuaries, for example Bandipur vs Gir, an increase in SR was followed by a corresponding increase in FPD (Table 2: scenario 1) as is expected from Fig. 4. However, in some comparisons this pattern is not seen. First, there were multiple pairs of sanctuaries which had similar SR but different FPD (Table 2: scenario 2). For example, Ranthambore and Bandipur had the same SR but Bandipur had higher FPD, similarly Kaziranga and Corbett had the same SR but Kaziranga had higher FPD. Thus, for a given SR, FPD might vary across regions. Interestingly, Corbett had higher SR than Anaimalai, but its FPD was lower than Anaimalai (Table 2: scenario 3). Lastly, Namdapha had the highest SR; however, its FPD was comparable to Kaziranga (Table 2: scenario 4). Thus, areas with high SR might sometimes harbour relatively low FPD (Namdapha), and similarly, areas with relatively low SR might sometimes harbour high FPD (Kaziranga). Taken together, these results suggest that SR does not accurately reflect FPD, and these two measures of diversity need not be correlated.

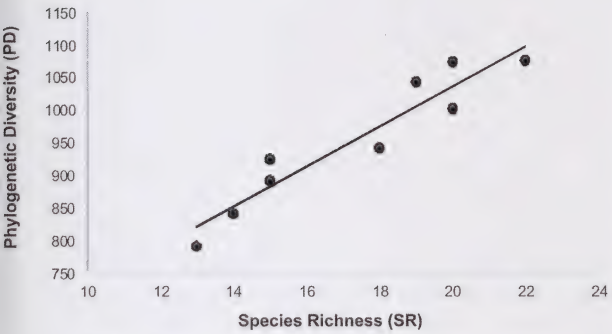

Fig. 4: Correlation between species richness (SR) and phylogenetic diversity (PD) measure

Clearly, for a meaningful comparison of PD across regions it is necessary to control for SR while calculating PD. The MPD (Mean Phylogenetic Distance) analysis shows that when one corrects for species numbers, the trend of PD values across these sanctuaries is quite different (Fig. 6). Importantly, the rank order of these PD values based on MPD (Fig. 6) is different from those based on FPD (Fig. 5). For example, whereas high SR areas like Kaziranga and Namdapha also show high MPD (as well as FPD), areas with low SR, Dachigam and Gir, actually harbour much higher MPD than Kanha and Corbett that exhibit higher SR. Anaimalai which has lower SR than Corbett exhibits more than twice the MPD of Corbett.

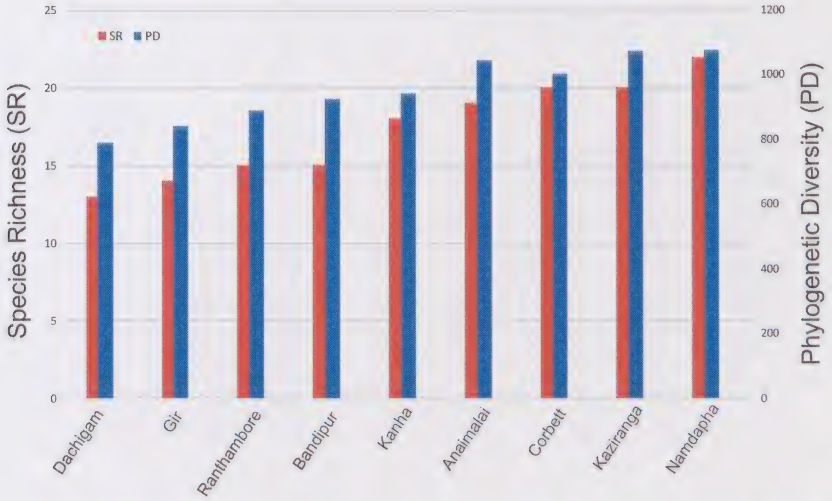

Fig. 5: Comparing species richness (in red) and phylogenetic diversity (in blue) across the nine sanctuaries for large mammal diversity across India. The sanctuaries have been ranked according to increasing SR

Table 2: Pairwise comparisons of sanctuaries and their SR and PD values

Scenario 1: Example Dachigam (A) vs Gir (B)		
SR	A>B	Expected under the assumption that PD is positively correlated with SR, area A has higher overall diversity than B, area A has priority over B for conservation action
PD	A>B	
Scenario 2: Example Bandipur (A) vs Ranthambore (B)		
SR	A=B	Species in area A are phylogenetically diverse and therefore area A has higher overall diversity than B, area A has priority over B for conservation action
PD	A>B	
Scenario 3: Example Corbett (A) vs Anaimalai (B)		
SR	A>B	Species in area A are phylogenetically similar, in area B phylogenetically diverse; area B has higher PD than A, area B has priority over A for conservation action
PD	A<B	
Scenario 4: Example Namdapha (A) vs Kaziranga (B)		
SR	A>B	Species in area B phylogenetically diverse; higher risk of loss of PD in area B, therefore area B has priority over A for conservation action
PD	A~B	

Decoupling of PD from SR can also be studied by comparing the observed MPD with the expected MPD for a given SR. The results from MPD-ses analysis show quite an interesting pattern (Fig. 7). Here again, areas with high MPD Anaimalai, Kaziranga, and Namdapha exhibit greater than expected PD for their respective SR. However, the remaining areas harbour less than expected MPD, with the exception of Gir and Bandipur which are close to expected. Kanha and Corbett, that harbour moderate to high SR, exhibit the highest negative deviation from expected MPD. Overall the MPD and MPD-ses analyses suggest that Anaimalai, Kaziranga, and Namdapha exhibit the highest PD followed by Bandipur and Gir, and the remaining sanctuaries fall in the lower end of the spectrum.

Taken together, these analyses suggest that even though there is an overall trend of positive correlation between SR and PD, these measures are actually decoupled. Some areas might have high PD despite having low SR, and vice versa. A comparison between Anaimalai and Corbett illustrates this point. Anaimalai has among the highest MPD and MPD-ses values, whereas Corbett has among the lowest, but Corbett has higher SR than Anaimalai. Areas with high MPD and MPD-ses values deserve higher prioritization for conservation, given that fewer distantly related species are contributing to the high PD. This is because in such phylogenetically dispersed communities, loss of a few species will result in dramatic fall in PD, whereas in communities with low PD but high SR, loss of species will not cause a

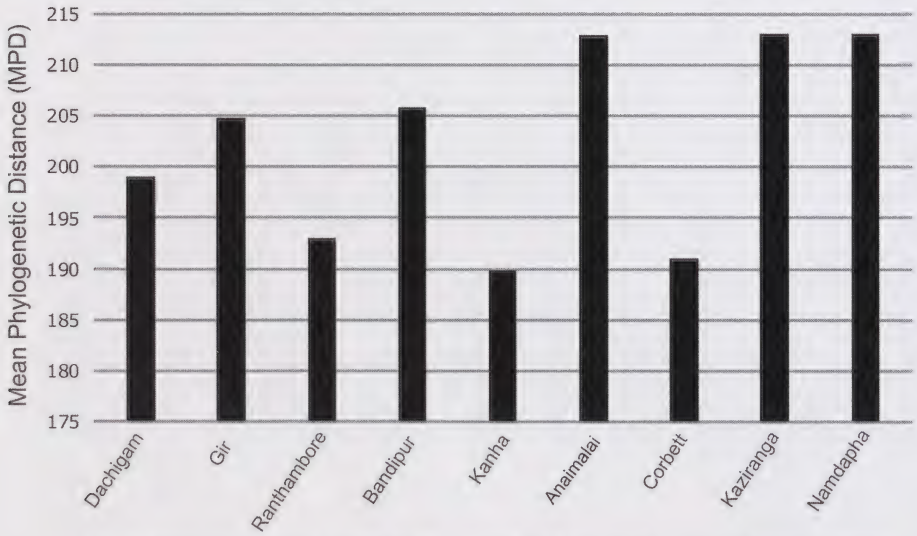

Fig. 6: Mean phylogenetic distance (MPD) used as a measure to calculate phylogenetic diversity. This index corrects for species numbers so is independent of SR. The sanctuaries have been ranked according to increasing SR

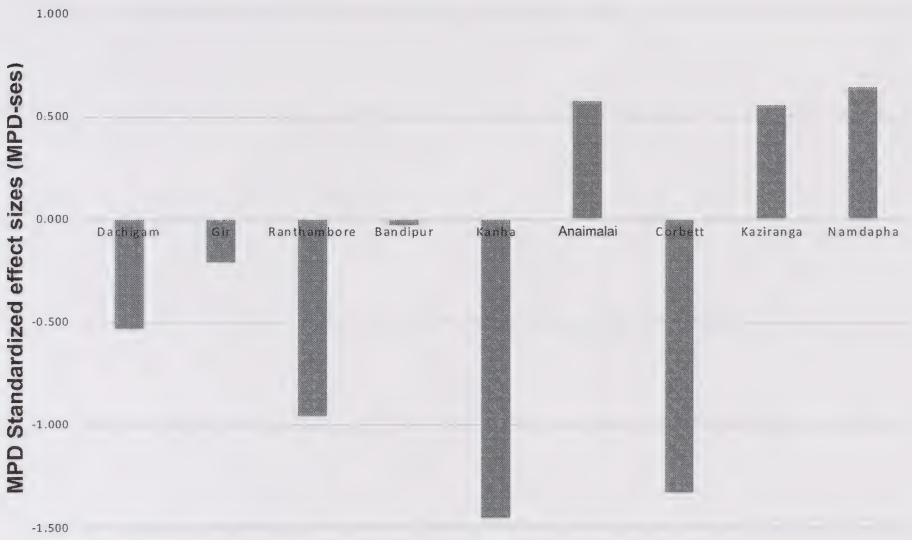

Fig. 7: Standardized effect sizes (MPD-ses) for phylogenetic diversity as plotted on a null distribution of expected values for a given number of species.
The sanctuaries have been ranked ordered according to increasing SR

dramatic fall in PD. Such communities are phylogenetically clumped, i.e., consist of many closely related, probably "redundant" species.

Furthermore, the decoupling between SR and PD can stem from various processes whose effects can be measured on different spatial scales. On the larger global scales, this decoupling can stem from area-of-origin, with the regions where the core lineages of the group evolved, exhibit larger PD for the given SR (Davies and Buckley 2011). At the more local community levels, the effects of community assembly processes such as habitat filtering or competitive exclusion can lead to such decoupling.

These results have important conservation implications (summarized in Table 2). Ideally, both SR and PD must be used for prioritizing areas for conservation action, and areas with higher SR as well as PD, i.e., higher overall diversity, must be given priority for conservation action (Scenario 1). In the case of areas with similar SR, PD can be used to prioritize areas for conservation (Scenario 2). Importantly, areas with relatively low SR should not be automatically accorded low priority, as they might be harbouring a phylogenetically diverse community (high PD, Scenario 3). Another interesting comparison is between areas with similar PD but different SR (Scenario 4). Here one might be tempted to use SR to prioritize areas for conservation. However, in such cases, areas with low SR harbour phylogenetically diverse communities and a few extinctions in this area might result in dramatic reduction of PD. On the other hand, in areas with higher SR, more species are contributing to the same PD value, therefore such areas are less prone to loss of PD due to extinction.

These results suggest that using SR as the sole diversity measure might be problematic as it tends to underestimate true diversity. However, we do not advocate replacing SR with PD; instead we recommend using both diversity measures when possible. Additionally, one should be aware of the pitfalls in using SR in diversity studies when it is the only diversity measure used.

Limitations of PD as a measure of diversity

The greatest limitation in the use of PD as a measure of diversity is the lack of sequence data for a vast majority of species. Furthermore, generating sequence data requires a molecular lab with basic facilities, and sequencing costs can be prohibitively high. Thus universities and colleges with limited resources might not be able to undertake such studies. This is a serious limitation that will compel researchers to concentrate on groups for which phylogenetic data is available or is easy to generate. Interestingly, this might not be an issue, given that groups for which genetic data is available also happen to be groups that are often used in accessing biodiversity based on SR; these include birds, mammals, butterflies, tree species etc. Additionally, with sequencing technology becoming easily accessible and the cost of sequencing dropping rapidly, some of these limitations will ease in the future. On the technical front, there is the issue of the choice of marker for calculating PD.

Given there is rate heterogeneity across genes, different genes might generate slightly different PD values for the same set of species. Furthermore, rates of molecular evolution for a gene can also vary across phylogeny, thereby giving inflated PD for certain combinations of species. These issues need to be addressed and we need to understand their influence on the calculation of PD.

It is also to be noted that while PD can be used to gain insights into the evolutionary diversity of communities and can help to identify conservation prioritization, it must be used with caution, taking into account other features of the target community. For example, a community in an ecotonal zone can exhibit high PD and low SR due to the presence of diverse lineages (Forest *et al.* 2007). Additionally, if the conservation focus is on preserving rare and endemic species, a newer method of analysis called Phylogenetic Endemism (PE) can be employed (Rosauer *et al.* 2009), wherein PD is measured against the distribution of each species. This method can help identify areas of relict short-range species even if the overall community PD is low (for example, if dominated by recently evolved radiations). The purpose of this paper is to illustrate the use and importance of PD in conservation biology, and not conservation prioritization of these nine sanctuaries. As discussed above, PD patterns are also scale dependent, and areas or communities should be chosen according to the question that needs to be addressed. These sanctuaries have been used as hypothetical examples of "comparable" areas for this analysis.

ACKNOWLEDGEMENTS

This project was partly funded by DBT-IISc partnership program and grants from Ministry of Environment, Forest and Climate Change (MoEF&CC) Govt. of India. We would like to thank the anonymous reviewer for comments on the manuscript.

REFERENCES

Bertrand, Y., F. Pleijel & G. Rouse (2006): Taxonomic surrogacy in biodiversity assessments, and the meaning of Linnaean ranks. *Systematics and Biodiversity 4*: 149–159.

Brooks, T.M., R.A. Mittermeier, G.A. da Fonseca, J. Gerlach, M. Hoffmann, J.F. Lamoreux, C.G. Mittermeier, J.D. Pilgrim & A.S. Rodrigues (2006): Global biodiversity conservation priorities. *Science 313(5783)*: 58–61.

Cadotte, M.W., T. Jonathan Davies, J. Regetz, S.W. Kembel, E. Cleland & T.H. Oakley (2010): Phylogenetic diversity metrics for ecological communities: integrating species richness, abundance and evolutionary history. *Ecology Letters 13*: 96–105. First published December 21, 2009.

Caldecott, J. (1996): Designing conservation projects: people and biodiversity in endangered tropical environments. Cambridge University Press. xxii + 312 pp.

Crozier, R. (1997): Preserving the information content of species: genetic diversity, phylogeny, and conservation worth. *Annual Review of Ecology and Systematics 28*: 243–268.

Datta-Roy, A. & K.P. Karanth (2009): The Out-of-India hypothesis: What do molecules suggest? *Journal of Biosciences 34(5)*: 687–697.

Davies, T.J. & L.B. Buckley (2011): Phylogenetic diversity as a window into the evolutionary and biogeographic histories of present-day richness gradients for mammals. *Philosophical Transactions of the Royal Society of London. Series B. Biological Sciences 366(1576)*: 2414–2425.

Faith, D.P. (1992): Conservation evaluation and phylogenetic diversity. *Biological Conservation 61(1)*: 1–10.

Forest, F., R. Grenyer, M. Rouget, T.J. Davies, R.M. Cowling, D.P. Faith, A. Balmford, J.C. Manning, S. Proches, M. van der Bank, G. Reeves, T.A. Hedderson & V. Savolainen (2007): Preserving the evolutionary potential of floras in biodiversity hotspots. *Nature 445(7129)*: 757–760.

Freemark, K.E., M. Meyers, D. White, L.D. Warman, A.R. Kiester & P. Lumban-Tobing (2006): Species richness and biodiversity conservation priorities in British Columbia, Canada. *Canadian Journal of Zoology 84(1)*: 20–31.

Gerlach, J. (2008): Preliminary conservation status and needs of an oceanic island fauna: the case of Seychelles insects. *Journal of Insect Conservation 12*: 293–305.

Harmon, L.J., J.T. Weir, C.D. Brock, R.E. Glor & W. Challenger (2008): GEIGER: investigating evolutionary radiations. *Bioinformatics 24(1)*: 129–131.

Izsák, J. & L. Papp (2000): A link between ecological diversity indices and measures of biodiversity. *Ecological Modelling 130(1)*: 151–156.

Karanth, K.P., L. Singh, R.V. Collura & C.B. Stewart (2008): Molecular phylogeny and biogeography of langurs and leaf monkeys of South Asia (Primates: Colobinae). *Molecular Phylogenetics and Evolution 46(2)*: 683–694.

Kembel, S.W. (2009): Disentangling niche and neutral influences on community assembly: assessing the performance of community phylogenetic structure tests. *Ecology letters 12(9)*: 949–960.

Kembel, S.W., P.D. Cowan, M.R. Helmus, W.K. Cornwell, H. Morlon, D.D. Ackerly, S.P. Blomberg & C.O. Webb (2010): Picante: R tools for integrating phylogenies and ecology. *Bioinformatics 26(11)*: 1463–1464.

Kerr, J.T. (1997): Species richness, endemism, and the choice of areas for conservation. *Conservation Biology 11(5)*: 1094–1100.

Maes, D., D. Bauwens, L. De Bruyn, A. Anselin, G. Vermeersch, W. Van Landuyt, G. De Knijf & M. Gilbert (2005): Species richness coincidence: conservation strategies based on predictive modelling. *Biodiversity & Conservation 14(6)*: 1345–1364.

Médail, F. & P. Quézel (1999): Biodiversity Hotspots in the Mediterranean Basin: setting global conservation priorities. *Conservation Biology 13(6)*: 1510–1513.

Mittermeier, R.A. (1997): Megadiversity: Earth's Biologically Wealthiest Nations. Cemex and Agrupacion Sierra Madre. 501 pp.

Myers, N., R.A. Mittermeier, C.G. Mittermeier, G.A.B. Da Fonseca & J. Kent (2000): Biodiversity hotspots for conservation priorities. *Nature 403*: 853–858.

Paradis, E., J. Claude & K. Strimmer (2004): APE: analyses of phylogenetics and evolution in R language. *Bioinformatics 20(2)*:

289–290.

Pérez-Losada, M. & K. Crandall (2003): Can taxonomic richness be used as a surrogate for phylogenetic distinctness indices for ranking areas for conservation? *Animal Biodiversity and Conservation 26(1)*: 77–84.

Polasky, S., B. Csuti, C.A. Vossler & S.M. Meyers (2001): A comparison of taxonomic distinctness versus richness as criteria for setting conservation priorities for North American birds. *Biological Conservation 97(1)*: 99–105.

R Core Team (2015): R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria. Available online at https://www.R-project.org/

Rodrigues, A.S. & K.J. Gaston (2002): Maximizing phylogenetic diversity in the selection of networks of conservation areas. *Biological Conservation 105*: 103–111.

Rosauer, D., S.W. Laffan, M.D. Crisp, S.C. Donnellan & L.G. Cook (2009): Phylogenetic endemism: a new approach for identifying geographical concentrations of evolutionary history. *Molecular Ecology 18(19)*: 4061–4072.

RStudio Team (2015): RStudio: Integrated Development for R. RStudio, Inc., Boston, MA. http://www.rstudio.com/

Safi, K., M.V. Cianciaruso, R.D. Loyola, D. Brito, K. Armour-Marshall & J.A.F. Diniz-Filho (2011): Understanding global patterns of mammalian functional and phylogenetic diversity. *Philosophical Transactions of the Royal Society of London. Series B. Biological Sciences 366(1577)*: 2536–2544.

Schweiger, O., S. Klotz, W. Durka, & I. Kühn (2008): A comparative test of phylogenetic diversity indices. *Oecologia 157(3)*: 485–495.

Swofford, D.L. (2003): PAUP*. Phylogenetic Analysis Using Parsimony (*and Other Methods). Version 4.0b 10.

Tamura, K., D. Peterson, N. Peterson, G. Stecher, M. Nei & S. Kumar (2011): MEGA5: molecular evolutionary genetics analysis using maximum likelihood, evolutionary distance, and maximum parsimony methods. *Molecular Biology and Evolution 28(10)*: 2731–2739.

Vane-Wright, R.I., C.J. Humphries & P.H. Williams (1991): What to protect? Systematics and the Agony of Choice. *Biological Conservation 55*: 235–254.

Villalobos, F., R. Dobrovolski, D.B. Provete & S.F. Gouveia (2013): Is rich and rare the common share? Describing biodiversity patterns to inform conservation practices for South American anurans. *PLoS ONE 8(2)*: e56073.

Recommended Citation

Karanth, K. Praveen, Srishti Gautam, Kunal Arekar and B. Divya (2019): Phylogenetic diversity as a measure of biodiversity: pros and cons. *J. Bombay Nat. Hist. Soc. 116*: 56–65. doi: 10.17087/jbnhs/2019/v116/120848

CONSERVATION CHALLENGES OF THE HERONRIES IN KERALA[1]

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[1]Accepted April 04, 2019
First published: December 31, 2019 | doi: 10.17087/jbnhs/2019/v116/131385
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Sixteen species of colonial waterbirds are known to breed in Kerala, with most of their breeding sites located near human habitations. The proximity of heronries to human habitation areas makes them prone to various anthropogenic disturbances. Urban expansion and infrastructure developments are the major causes leading to the decline and loss of breeding sites in recent years. In general, heronries in human habitation areas do not get public support due to the foul smell from faecal droppings and food waste, and due to the raucous calls made by the breeding birds and their nestlings. Thus, conservation of heronries is a great challenge in Kerala, more so since none of these heronries have protected status. This paper discusses the conservation issues of the heronries of Kerala, based on surveys carried out from July to August 2015 on 188 heronries, spread across 10 districts.

Keywords: Heronry, colonial waterbirds, wetlands, conservation, threats

INTRODUCTION

Situated in the tropics, Kerala lies in the south-western part of the Indian peninsula, and is bounded by the Western Ghats on the east, the Arabian Sea on the west, and by the states of Karnataka to the north and Tamil Nadu to the east and south. Kerala encompasses an area of 38,864 sq. km, and experiences two monsoons, the southwest monsoon during June–September and northeast monsoon in October–November, resulting in waterlogged conditions in 20% of the geographic area (Kokkal *et al.* 2008). Kerala has a 590 km coastline with a network of lagoons and backwaters; and besides these wetlands, the state has a number of lakes, rivers, and canals. A study reported 217 wetland areas in the state, of which 157 are >56 ha, these comprise 64 inland wetlands and 93 coastal wetlands (Nair *et al.* 2001). Kerala also has extensive areas under paddy cultivation, which are waterlogged for most of the year. This vast and diverse spread of wetlands supports substantial populations of resident and migratory waterbirds (Praveen 2015).

Kerala has a number of heronries which have been monitored in recent years by the Kerala Forests and Wildlife Department in association with various NGOs of the state (Roshnath *et al.* 2017a, b; Sashikumar and Jayarajan 2007, 2008; Sashikumar *et al.* 2011, 2015). Unlike the bordering state of Tamil Nadu, where most of the heronries are found in or around wetlands, mostly on partially submerged trees within water tanks (Subramanya 2005), the heronries of Kerala are located along highways and urban towns, and have no protected status. Heronries located in human habitation areas along roads, bus stops, non-residential compounds (such as offices, temples, and hospitals), and residential areas are often regarded as a nuisance due to the foul smell emanating from the faecal droppings, decaying fallen food (mostly fish), and the continuous chatter of the breeding birds and their nestlings. As most of the heronries are located in government land, many roadside trees are cut on occasion for road expansion and other development activities (Sashikumar *et al.* 2015). Hence, the heronries generally do not get either public or governmental support, and their conservation is a great challenge.

Heronry database referred

There have been a number of district-wise surveys to monitor heronries in Kerala in recent years (Roshnath *et al.* 2013; 2017a, b, 2018; Sashikumar and Jayarajan 2007, 2008; Sashikumar *et al.* 2011; 2015; Table 1). For this study, we have used only the data of the 2015 survey by Sashikumar *et al.* (2015), as it covered most of the districts of the state (10 districts, excluding Thiruvananthapuram, Ernakulam, Idukki, and Kollam), and the survey was carried out with a standardized survey protocol.

RESULTS AND DISCUSSION

Conservation issues

In all, 188 heronries were recorded during the 2015 survey, of which 78% of nests were in or around human habitation areas. More than half (57.8%) of the 11,490 nests recorded were situated in trees growing along roads, while 20.1% were in trees growing in residential and non-residential areas. Only about a quarter of the nests were located in wetlands

Table 1: Heronry surveys conducted in Kerala

Year	District	References
1995	Kasaragod, Kannur	Palot 1996
2004	Kumarakom in Alappuzha	Narayanan and Vijayan 2007
2006	Kasaragod, Kannur, Calicut, Malappuram, Palakkad, Wayanad	Unpublished
2007	Kasaragod, Kannur, Calicut, Malappuram, Palakkad, Wayanad	Sashikumar and Jayarajan 2007
2008	Kasaragod, Kannur, Calicut, Malappuram, Palakkad, Wayanad	Sashikumar and Jayarajan 2008
2010	Kasaragod, Kannur, Calicut, Malappuram, Palakkad, Wayanad	Sashikumar *et al.* 2011
2013	Kannur	Roshnath *et al.* 2013
2014	District surveys excluding Thiruvananthapuram, Ernakulam, Idukki, and Kollam	Sashikumar *et al.* 2015
2015	District surveys excluding Thiruvananthapuram, Kollam, Ernakulam, and Idukki	Roshnath *et al.* 2017a
2016	Trivandrum, Kollam, Kottayam, Pathanamthitta, Alappuzha, Thrissur, Kannur, and Kasaragod	Roshnath *et al.* 2017b
2017	Kasaragod, Kannur, Calicut, Wayanad, Thrissur	Roshnath *et al.* 2018

(Table 2). The threats faced by the heronries in Kerala are discussed in greater detail further on, and the threats faced by the 15 major heronries of Kerala are summarized in Table 3.

Loss of nesting sites

Loss of nesting sites due to cutting of branches or whole tree felling due to nuisance created by the breeding birds or for road development is the major threat faced by heronry birds in Kerala. The Government of Kerala is currently focusing on infrastructural development and welcomes new enterprises to boost the economic growth of the state. This has resulted in large-scale changes in land-use pattern, impacting wetlands and other areas rich in biodiversity. Since 2001, Kerala has shown a rapid increase in urbanization, with the highest growth rate of urban population recorded during the last few years among the major states of India (Sabida and Laya 2016).

Looking at the colonization pattern of the heronry birds in Kannur district as an example, it was found that these birds colonized the areas by the 1990s, continued to expand till 2010, and then declined drastically after 2011, which can be linked with the urbanization pattern. Since most of the heronries in Kerala are located at roadsides, the losses are largely due to developmental activities related to road widening, laying of electric/pipeline, and town expansion along the roads.

Table 2: Location of heronries in Kerala as per the 2015 survey

Site	No. of heronries with percentage values	No. of nests with percentage values
Along roadsides	135 (71.8)	6639 (57.8)
Wetlands	13 (6.9)	2540 (22.1)
In non-residential compounds (offices, temples, hospitals, etc.)	21 (11.2)	1457 (12.7)
In residential compounds	18 (9.6)	853 (7.4)
Mobile towers	1 (0.5)	1 (0.0)
Total no. of heronries/nests	188	11,490

Another example of degradation of a nesting site is the Panamaram heronry in Wayanad district, which comprises bamboo clumps growing on a sandbank islet in the Kabani river. This mixed heronry with nine species of birds is one of the largest nesting sites for the threatened Black-headed Ibis *Threskiornis melanocephalus* in Kerala. It is now threatened by sand mining in the river, which has resulted in bank erosion and felling of bamboos.

Alappuzha district has expansive wetlands and supported a large population of breeding heronry birds. Wetlands on either side of the Vada Canal supported 610 nests of heronry birds, comprising the second largest heronry in Kerala, according to the 2015 survey. But local disturbances and felling of trees have been threats, and there has been a decrease in the numbers of nesting birds (Hari M., pers. comm. Sept 12, 2015). Pallippad Puncha heronry, also in Alappuzha district, faces disturbances from land owners. Burning of nesting trees in Palakkad (S. Raju, pers. comm. Sept 12, 2015) and cutting of branches of nesting trees in the parking lots at Kanhangad railway station in Kasaragod district have resulted in a general decrease in the number of nesting birds.

Public attitude and the conservation challenge

The attitude of the local people towards the heronries was found to be not generally conservation supportive. At many heronries, the locals considered the nesting birds a nuisance due to their droppings, rotting fallen food, and dead

Table 3: Threats faced by the major heronries of Kerala recorded during the 2015 survey

Site / Heronry	District	Habitat	No. of nests	Threats
Panamaram	Wayanad	River	648	Sand mining
Vada Canal	Alappuzha	Wetland	610	Tree felling, lighting fire-crackers
Ennakkad	Alappuzha	Islet of *Acacia*	448	No threat, being an isolated islet
Kallettumkara	Thrissur	Non-residential area (railway station)	443	Lighting fire-crackers and cutting trees/branches
Mahe Church	Mahe	Roadside	265	Disturbance during nesting season
Pallippad Puncha	Alappuzha	Residential compound near wetland	258	Disturbance during nesting season
Naniyoor	Kannur	Islet of mangroves	237	No present threat (poaching reported earlier)
Pittupeedika	Palakkad	Roadside	237	Cutting of branches and death of trees due to guano deposit
Valapattanam	Kannur	Mangroves	218	Encroachments by timber factory
Nagampadom	Kottayam	Roadside	218	Road widening and public nuisance
Kanhangad	Kasaragod	Non-residential area (railway station)	208	Cutting of tree branches
Pavukkara	Alappuzha	Residential compound near wetland	206	Tree damage from guano deposit
Klari, MSP camp	Malappuram	MSP compound	203	No threat inside Malabar Special Police compound
Pazhambalakode	Palakkad	Roadside	185	Cutting of tree branches, felling trees
VK Padi	Malappuram	Roadside	177	Cutting of tree branches

chicks, and people mostly drove them away even before the beginning of the breeding season. The nuisance caused by heronries located in crowded places like auto/taxi stands or bus stops/shelters in towns, prompted people to scare and disturb birds during nesting. The deterrent methods include bursting crackers, hanging up tin cans on branches to generate noise, and throwing stones. The people's attitude towards roosting sites is also negative. Furthermore, heronry species like cormorants and egrets are considered by fishermen to be a threat to commercial fisheries, and pests for the fish-farming community (Roshnath *et al.* 2014).

Tourism

Unrestricted tourism in heronry sites such as Kumarakom was also found to disturb nesting birds. Human footfall in heronries has no ill effect when an appropriate buffer area is provided (Burger *et al.* 1995). A study in a mixed heronry found that 30–50 m was the average distance taken by birds to flush out when approached (Erwin *et al.* 1998), and considering this, a buffer zone of 100 m to minimize disturbance in colony was advised (Rodgers and Smith 1995). But such buffers are not practical in most of the sites in Kerala, as they are located in human settlements. We also found that most of these birds tolerate human presence, unless they are intentionally disturbed.

Poaching

There are occasional reports of hunting of birds such as egrets, herons, cormorants, and darters for the pot or as a sport throughout the state. Egg collection was also observed in some sites. These are mostly recorded in heronries that are located in rural or interior parts. In Alappuzha district, there were many reports of poaching of Oriental Darter *Anhinga melanogaster* chicks for meat, which was available in local toddy shops (Hari M., pers. comm. Sept 12, 2015), even though all these species are protected under the Wildlife (Protection) Act of 1972. Similarly, at Naniyoor and Valapattanam mangrove islets, which support the largest heronries in Kannur district, poaching and egg collection were reported.

Loss of wetlands and mangroves

With high population density and spread of human habitations in the state, wetlands in Kerala are under severe anthropogenic threats (Raj and Azeez 2009). A large proportion of agricultural land in Kerala has already been converted into small-scale plantations of coconut and rubber, or cropping systems consisting of fewer crop species due to commercialization and fragmentation of land holdings (Kumar 2005).

Paddy fields are used for foraging by waterbirds. The Kerala Conservation of Paddy Land and Wetland Act 2008

was introduced to stop the massive conversion of paddy fields to housing or other uses; this would also help protect the wetland ecosystem in the state. However, environmentalists are now concerned about the upcoming new amendments to the Act, which would pave the way for real estate firms to take over paddy fields.

Although Kerala had seen an increase in the mangrove cover, especially in North Kerala (Radhakrishnan *et al.* 2006) in recent years, there have been instances of mangrove destruction in many parts of the state since 2010. Rapid urbanization, conversion of mangrove area to coconut plantations, agriculture, and ecotourism are the main drivers of mangrove loss in the state (Mohanan 2004).

Other threats

An indirect threat to birds is due to the excessive use of agrochemicals. There were reports about the death of Indian Pond-heron *Ardeola grayii* and egrets in agricultural fields in Kannur district in 2016, suspected to be due to pesticide poisoning. Pesticide-induced deaths in birds are difficult to monitor, as the birds die on site, carcasses decompose quickly or may be eaten by scavengers, and thus only a small proportion of deaths will be documented (Mitra *et al.* 2011). Hence, unless a large number of birds die due to poisoning, such events do not catch the attention of the public. Heavy guano deposits may affect the nesting tree; e.g. an *Artocarpus hirsutus* tree in Pavukkara heronry in Alappuzha was found to be impacted by bird droppings and eventually dried up.

RECOMMENDATIONS

1. Site Management

Protection should be afforded to all the large heronries situated in public places, especially during the breeding season, and watchers should be appointed for the season. Proper management of identified nesting sites and trees should be considered. Trimming of branches which grow towards electric lines is a necessity, but this should be done prior to or after the nesting season. To compensate for the loss of nesting trees, appropriate tree species should be planted.

2. Monitoring

The heronries should be visited by the officials of the local forest department periodically during the breeding season. With the help of local birdwatchers, conservation groups should be created similar to the Eco Development Committees (EDC) or Vana Samrakshana Samithis (VSS). These groups should monitor the heronries, create awareness in the general public, and protect the heronries from possible threats.

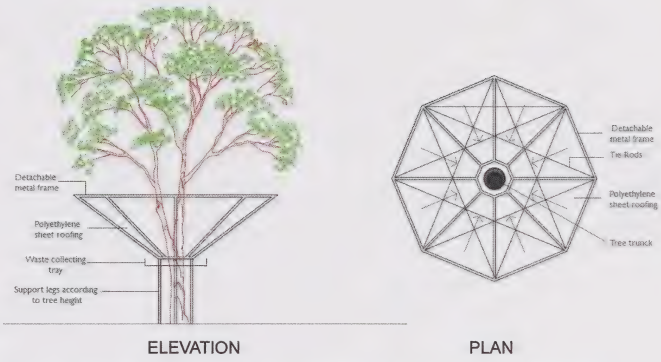

Fig 1: Model of heronry guard (designed by Praveen Mohandas)

Some members of these groups could be trained for data collection.

3. Awareness

Awareness programmes for heronry birds, highlighting their importance and role in the agricultural and wetland ecosystems, nesting preferences, and threats, should be organized in public places, schools, colleges, etc. Informative posters regarding nesting bird species should be placed under the nesting trees to draw public attention and to create awareness, which would help to protect the trees.

4. Heronry guard

In the case of heronries in public places, where people complain of the nuisance caused by droppings, etc., tarpaulin sheets need to be placed below the nest trees. Such an example was seen in Kuthuparamba bus stand, Kannur district, where the *panchayat* (village council) erected a canopy of tarpaulin sheets under the nesting tree at the bus shelter, and green garden sheets over a taxi stand. At some suitable sites, permanent structures such as "heronry guards" (Fig. 1) can be erected, and if found successful, they can also be put up in other places.

ACKNOWLEDGEMENTS

We thank all the survey district coordinators: Sathyan Meppayur, M. Jafer Palot, Raju S., Vijesh Vallikkunnu, Binu C., Vishnudas C.K., Manoj K., Bimalnath K.G., Syam, Aravind B., Rafi Kallettumkara, Praveen E.S., Sandeep Das, Harikumar, Dr B. Sreekumar, Giju Kumarakom, Dipu S., Deepak Dayanandan, Ajai P., Saju Vasan, Hari Mavelikara, A.K. Sivakumar, Jaichand Johnson, Neha Waiker, Sayoojya Anand, Gopi, and Sunil Kumar. We acknowledge Kerala Forest Department for facilitating the surveys. We would also like to thank Praveen Mohandas for designing the heronry guard model, and Praveen J. and Nameer P.O. for their support and coordination.

REFERENCES

BURGER, J., M. GOCHFELD & L.J. NILES (1995): Ecotourism and birds in coastal New Jersey: contrasting responses of birds, tourists, and managers. *Environ. Conserv. 22*: 56–65.

ERWIN, R., M.J.D. NICHOLAS, T.B. EYLER, D.B. STOTTS & B.R. TRUITT (1998): Modelling colony-site dynamics: A case study of Gull-billed Terns (*Sterna nilotica*) in coastal Virginia. *Auk 115*: 970–978.

KOKKAL, K., P. HARINARAYANAN & K. SABU (2008): Wetlands of Kerala. *In*: Sengupta, M. and R. Dalwani (Eds): Proceedings of Taal 2007: The 12th World Lake Conference, pp. 1889–1893.

KUMAR, B.M. (2005): Land use in Kerala: changing scenarios and shifting paradigms. *J. Trop. Agri. 42*: 1–12.

MITRA, A., C. CHATTERJEE & F.B. MANDAL (2011): Synthetic chemical pesticides and their effects on birds. *Res. J. Environ. Toxicol. 5*: 81–96.

MOHANAN, C. (2004): "Conservation of the fragile ecosystem diversity of Kerala", Centre for Earth Science Studies, Internal Report, pp. 381–398.

NAIR, A.S.K., G. SANKAR & K.J. MATHEW (2001): Estimation of wetlands in Kerala using IRS data. Proc. 13th Kerala Science Congress, KSCSTE, Govt of Kerala, pp. 60–61.

NARAYANAN, S.P. & L. VIJAYAN (2007): Status of the colonial breeding waterbirds in Kumarakom heronry in Kerala, southern India. *Podoces 2*: 22–29.

PALOT, M.J. (1996): A study on the wetlands and wetland birds of North Malabar, Kerala. Report submitted to Council for Scientific and Industrial Research (CSIR), New Delhi.

PRAVEEN, J. (2015): A checklist of birds of Kerala, India. *Journal of Threatened Taxa 7(13)*: 7983–8009.

RAJ, P.P.N. & P.A. AZEEZ (2009): Real estate and agricultural wetlands in Kerala. *Economic and Political Weekly 44(5)*: 63–66.

RADHAKRISHNAN, C., K.C. GOPI & M.J. PALOT (2006): Mangroves and their faunal associates in Kerala, with special reference to northern Kerala. Records of Zoological Survey of India, Occasional paper No. 246, 1–81.

RODGERS, J.A. & H.T. SMITH (1995): Set-back distances to protect nesting bird colonies from human disturbance in Florida. *Conserv. Biol. 9*: 89–99.

ROSHNATH, R., B. CHANDRAMOHAN & M. ASHOKKUMAR (2014): Bird menace: status, threats and mitigation measures in shrimp farms of Cuddalore and Villupuram districts of Tamil Nadu. *Fisheries Science.com 8(2)*: 131–138.

ROSHNATH, R., M. ASHOKKUMAR, R. UNNI, SREEJITH & A. JOSE (2013): Status of birds in heronries of Kannur district, Kerala. *Malabar Trogon 11*: 15–20.

ROSHNATH, R., C. SASHIKUMAR, C.K. VISHNUDAS, JAFER PALOT, S. RAJU, HARIKUMAR MANNAR, B. SREEKUMAR, HARI MAVELIKARA, A.K. SIVAKUMAR & SATHYAN MEPPAYUR (2017a): Heronries of Kerala 2015 – A summary of the Heronry Census. *Malabar Trogon 15*: 35–40.

ROSHNATH, R., C. SASHIKUMAR, P. GRESHAM, H. MANNAR, B. SREEKUMAR, H. MAVELIKARA & A.K. SIVAKUMAR (2017b): Kerala Heronry Survey 2016 – A Summary. *Malabar Trogon 15*: 41–45.

ROSHNATH, R., C. SASHIKUMAR, P. GREESHMA, J. PALOT & C.K. VISHNUDAS (2018): Heronry Survey in Kerala, 2017– A Summary. *Malabar Trogon 13(3)*: 67–70.

SABIDA, D.D.S. & K.S. LAYA (2016): Urbanization and development in Kerala. *Int. J. App. Res. 2(8)*: 586–590.

SASHIKUMAR, C. & O. JAYARAJAN (2007): Census of the heronries of north Kerala. *Malabar Trogon 5*: 2–8.

SASHIKUMAR, C. & O. JAYARAJAN (2008): Census of the heronries of north Kerala 2007. *Malabar Trogon 6*: 14–19.

SASHIKUMAR, C., C.K. VISHNUDAS, S. RAJU, P.A. VINAYAN & V.A. SHEBIN (2011): Heronries of North Kerala – 2011. *Malabar Trogon 9*: 10–16.

SASHIKUMAR, C., K.G. BIMALNATH, M. HARI, M. HARIKUMAR, E.S. PRAVEEN, S. RAJU, R. ROSHNATH, M. SATHYAN, B. SREEKUMAR, A.K. SIVAKUMAR, C.K. VISHNUDAS, J. PRAVEEN & P.O. NAMEER (2015): Heronries of Kerala – 2014. *Malabar Trogon 13*: 2–11.

SUBRAMANYA, S. (2005): Heronries of Kerala. *Malabar Trogon 3(1)*: 2–15.

Recommended Citation

Roshnath, R. and C. Sashikumar (2019): Conservation challenges of the heronries in Kerala. *J. Bombay Nat. Hist. Soc. 116*: 66–70. doi: 10.17087/jbnhs/2019/v116/131385

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NEW DESCRIPTIONS

A NEW SPECIES OF *BOIGA* FITZINGER, 1826 (SERPENTES: COLUBRIDAE) FROM THE NORTHERN WESTERN GHATS OF INDIA[1]

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[1]Accepted August 27, 2019
First published: September 26, 2019 | doi: 10.17087/jbnhs/2019/v116/144901
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List of Abbreviations: DSR - dorsal scale row; ES - eye to snout; HH - head height; HL - head length; HW - head width; FL - frontal length; FW - frontal width; IL - infralabial; OD - orbital diameter; PL - parietal length; PW - parietal width; SL - supralabial; TL - total length; TaL - tail length; NWG - Northern Western Ghats; WG - Western Ghats

A new species of colubrid snake of the genus *Boiga* Fitzinger, 1826 is described, based on three specimens. *Boiga thackerayi* sp. nov. is presently known only from its type locality from a hill stream near Koyna, Satara district in northern Western Ghats of peninsular India. A medium sized *Boiga* characterized by smooth dorsal scales arranged in 19/19-17/15 rows, ventrals 211–221; subcaudals 93–101, dorsum with indistinct bands and belly distinctly marked. This is the second species of *Boiga* after *B. dightoni* that is endemic to the Western Ghats and the first new species of *Boiga* described after 125 years from the Western Ghats. The molecular data also proved the distinctiveness of this species from its congeners from India and Sri Lanka, which was supported by a limited but precise set of morphological variations. This is apparently the first known species of *Boiga* which feeds on frog eggs.

Key words: *Boiga ceylonensis*, cat snake, DNA, taxonomy, types, wet zones

INTRODUCTION

Colubrid snakes of the genus *Boiga* Fitzinger, 1826 are distributed in Southwest and Central Asia through South and Southeast Asia to northern Australia, and are currently represented by 34 species (Uetz *et al.* 2019). With 16 chiefly arboreal and opisthoglyphous nominate species, *Boiga* is one of the most diverse colubrid genera that occurs in the Indian subcontinent. The species currently recognized from the Indian subcontinent are: *Boiga trigonata* (Schneider, 1802), *B. multomaculata* (Boie, 1827), *B. gokool* (Gray, 1835), *B. cyanea* (Duméril, Bibron & Duméril, 1854), *B. forsteni* (Duméril, Bibron & Duméril, 1854), *B. ceylonensis* (Günther, 1858), *B. multifasciata* (Blyth, 1861), *B. ochracea* (Theobald, 1868), *B. barnesii* (Günther, 1869), *B. nuchalis* (Günther, 1875), *B. dightoni* (Boulenger, 1894), *B. quincunciata* (Wall, 1908), *B. andamanensis* (Wall, 1909), *B. beddomei* (Wall, 1909), *B. siamensis* Nootpand, 1971, *B. wallachi* Das, 1998, and *B. flaviviridis* Vogel & Ganesh, 2013 (Smith 1943; Vogel and Ganesh 2013; Whitaker and Captain 2004).

Based on multiple studies on varied faunal groups, it is evident that Indian and Sri Lankan wet zone taxa show high degree of endemism compared to dry zone taxa (Agarwal *et al.* 2017; Biswas 2008; Bossuyt *et al.* 2004; Lajmi *et al.* 2018). Although *Boiga* is a genus that includes several species that are often common and apparently widely distributed, their phylogenetic relationships remain unclear due to insufficient taxon sampling (Figueroa *et al.* 2016; Mohan *et al.* 2018). Two species, *Boiga ceylonensis* and *B. beddomei*, with type localities in Sri Lanka, are also believed to occur across the entire Western Ghats.

Fieldwork in the Northern Western Ghats (NWG) resulted in the discovery of a population with divergent coloration and behaviour from all known species. We subsequently conducted a detailed study of the known species of *Boiga* with 19 midbody dorsal scale rows from the Western Ghats

After this manuscript appeared online, the BNHS registration numbers have been ammended – Authors.

and Sri Lanka. This included critical examination of types and representative specimens of these species from various museums. We used an integrative approach, combining data from morphology and phylogeny to address this taxonomic problem. Molecular data supports the distinctiveness of the NWG lineage from its congeners from India and Sri Lanka, which is corroborated by a limited but precise set of morphological variations. We formally describe the NWG lineage as a new species below.

MATERIAL AND METHODS

Molecular methods: We generated DNA sequence data for the new species of *Boiga* from Humbarli, Satara district, Maharashtra and *Boiga* cf. *flaviviridis* from Meghamalai, Tamil Nadu. Genomic DNA was extracted from muscle/liver tissue sample stored in absolute ethanol at -20° C. DNeasy (Qiagen™) blood and tissue kits were used to extract DNA. We amplified a partial fragment of the mitochondrial gene cytochrome b (*cytb*), totally ~1100 base pairs (Burbrink *et al.* 2000; Palumbi 1996). Sequences generated in this study were submitted to NCBI GenBank (Table 1), and combined with published sequences including representatives of all available *Boiga* spp. In all, we assembled a dataset containing 16 out of the 34 known species of *Boiga* (Uetz *et al.* 2019) with five from Sri Lanka and three from India.

Sequences were aligned using ClustalW with default settings (Thompson *et al.* 1994), and the alignment was checked for stop codons. Uncorrected pairwise genetic distances were calculated using MEGA 5 (Tamura *et al.* 2011).

Morphology: The type series of the new species, and syntypes of *B. beddomei*, and *B. ceylonensis* were examined. Other comparative material examined includes specimens of *B. ceylonensis* from Sri Lanka (n=9) and India (n=3). Material examined is listed in Appendix 1. Voucher specimens were studied from the following museums and institutions: BMNH (The Natural History Museum, London, UK), BNHS (Bombay Natural History Society, Mumbai, India), CAS (California Academy of Sciences, San Francisco, USA), FMNH (Field Museum of Natural History, USA), MCZ (Museum of Comparative Zoology, Cambridge, USA), ZMB (Museum für Naturkunde Berlin, formerly Zoologisches Museum Berlin, Germany), ZMH (Zoologisches Museum der Universität Hamburg, Germany) (Sabaj 2016). Further comparative data have been used from literature, especially from reviews and original descriptions (Das *et al.* 2010; Kroon 1973; Mohapatra *et al.* 2010; Smith 1943; Vogel and Ganesh 2013; Wall 1909; Whitaker and Captain 2004).

Table 1: GenBank accession numbers for DNA sequence data used in this study

S. No.	Species	Voucher number/Extraction ID	*Cytb*	Locality
1	*Boiga beddomei*	RAP0450	KC347466	Sri Lanka
2	*Boiga barnesii*	RAP0452	KC347469	Sri Lanka
3	*Boiga blandingii*	EBG 808	AY612037	Somoria, Guinea
4	*Boiga ceylonensis*	RS-Y	KC347467	Sri Lanka
5	*Boiga cyanea*	BC01150713	LC105641	Chantaburi, Thailand
6	*Boiga cynodon*	KU:324614	KC010340	Negros Island, Philippines
7	*Boiga dendrophila*	—	AF471089	—
8	*Boiga* cf. *flaviviridis*	NCBS VG 2110	MN508360	Meghamalai, Tamil Nadu, India
9	*Boiga forsteni*	RAP0540	KC347468	Sri Lanka
10	*Boiga irregularis*	—	FJ710794	—
11	*Boiga kraepelini*	—	FJ710796	—
12	*Boiga multomaculata*	—	FJ710798	—
13	*Boiga ocellata*	BS01100613	LC105640	Chantaburi, Thailand
14	*Boiga thackerayi* sp. nov.	BNHS 3569	MN508359	Koyna, Maharashtra, India
15	*Boiga trigonata*	RS-143	KC347475	Sri Lanka
16	*Boiga westermanni*	—	MG428713	India

Note: [—] indicates information not available

APPENDIX I

Comparative specimens of *Boiga* examined.
For institutional abbreviations see previous page.

1. *B. barnesii*
   BMNH 1946.1.1.33, Ceylon, Holotype.
   ZMH R05511, Ratnapura, Sri Lanka.

2. *B. beddomei*
   BMNH 93.10.6.3, BMNH 93.10.6.4, Trincomalee, Ceylon, Syntype.
   BMNH 69.8.28.123, Matheran, Bombay, Syntype.

3. *B. ceylonensis*
   BMNH 1946.1.4.71, BMNH 1946.1.1.29, BMNH 1946.1.4.81, BMNH 1946.1.4.78, BMNH 1946.1.4.79, BMNH 1946.1.4.80, Ceylon, Syntypes?
   CAS-SU 13091, Tamil Nadu.
   FMNH 120919, FMNH 131380, FMNH 165053, FMNH 167007, Ceylon .
   FMNH 217701, FMNH 217702, Ponmudi, Kerala.
   ZMB 3732, ZMB 4043, ZMB 8058, ZMB 49428, Ceylon.
   ZMB 7302, Peradenia, Ceylon.

4. *B. dightoni*
   BMNH 1946.1.1.32, Peermad, Holotype.
   FMNH 217699, Ponmudi, Kerala.

5. *B. nuchalis*
   BMNH 74.4.29.933, BMNH 74.4.29.934, Forests W. Coast India, Syntype.
   CAS 17247, Anaimalai.
   MCZ – R 3876, Tamil Nadu.
   MCZ – R 18062, Travancore.
   ZMB 6039, Nilgherries.

Total length (TL), snout-vent length (SVL) and tail length (TaL) were measured with thread and ruler to the nearest 1 mm. Other dimensions were recorded with dial callipers, to the nearest 0.1 mm. Dorsal scale rows were counted at one head-length behind neck, at midbody, and at one head-length anterior to the anal scute. Ventrals were counted according to Dowling (1951a). The terminal scale is not included in the subcaudal count. Dorsal scale reduction was determined according to Dowling (1951b). Values of bilateral pholidotic traits are given in left/right order.

The hemipenis of holotype BNHS 3569 was everted prior to fixation and was preserved using 2% formalin. Description of hemipenis characters and terminology follows Dowling and Savage (1960).

RESULTS

The uncorrected p-distance between *Boiga thackerayi* sp. nov. and *B. beddomei* is 13%, and between *B. thackerayi* sp. nov. and *B. ceylonensis* from Sri Lanka is 16%. The lowest and highest uncorrected p-distances between any two *Boiga* species pairs are 12% and 24%. Genetic divergence based on uncorrected p-distances for the cytochrome-b gene is provided in Table 2. We do not make phylogenetic inferences based on our dataset since it is limited to just the *cyt*b gene, and defer to Figueroa *et al.* (2016) for relationships within *Boiga*.

***Boiga thackerayi* sp. nov.**
(Figs 1–5; Table 4; Appendix 1)
Zoobank ID: urn:lsid:zoobank.org:act:F1A8F66D-7A06-4B98-AC0E-E3F14C249486

Holotype: BNHS 3569 (Fig. 1), adult male, collected from near Humbarli, Koyna, Satara district, Maharashtra, India, by Tejas Thackeray and Swapnil Pawar on July 27, 2016.

Paratypes: BNHS 3570 and BNHS 3571, both females, collected from near Humbarli, Koyna, Satara district, Maharashtra, India, by Tejas Thackeray and Swapnil Pawar on September 15, 2017.

Diagnosis: A medium sized *Boiga* with SVL up to 870 mm. Body laterally compressed with weakly enlarged vertebral scales; dorsal scales smooth without apical pits, in 19/19–17/15 rows; ventrals 211–221; subcaudals 93–101, paired; anal single; supralabials 8, 3rd–5th touching orbit; infralabials 9–11; rostral broader than high; preocular single, barely reaching upper surface of the head, not touching frontal; postoculars 2; temporals 2 in first row, 3–5 in second row; vertebral scale row differs from paravertebral rows in being slightly broader and with rounded posterior margins; dorsum brown with indistinct dark bands on the body and tail; dorsal aspect of head deeply pigmented with dark blotches, postocular stripe extending to the angle of the jaw; ventral aspect of body speckled throughout, contiguous series of irregularly arranged distinct, dark spots with pale borders on lateral aspect; in life the anterior portion of the venter is yellowish and the remaining posterior part pale pinkish in colour.

Description of holotype: Male. Good condition; *c.* 12 mm longitudinal ventral incision into coelom *c.* 445 mm from snout tip. Hemipenes everted, left hemipenis removed for detailed study (Fig. 1).

Body laterally compressed, higher (12.7 mm) than wide (9.7 mm) at midbody, with a distinct vertebral ridge

Table 2: Uncorrected *p*-distance matrix for the cytochrome-b gene

Sr.	Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	*Boiga beddomei*	-														
2	*Boiga barnesii*	15.8														
3	*Boiga blandingii*	19.1	19.0													
4	*Boiga ceylonensis*	15.8	15.2	20.7												
5	*Boiga cyanea*	19.4	18.3	21.6	19.3											
6	*Boiga cynodon*	20.5	20.1	19.4	20.9	16.8										
7	*Boiga dendrophila*	19.9	18.7	21.0	20.0	11.6	17.9									
8	*Boiga flaviviridis*	9.7	17.5	20.0	14.5	20.1	20.8	21.4								
9	*Boiga forsteni*	18.9	20.4	18.1	19.9	16.8	16.8	18.2	19.6							
10	*Boiga irregularis*	19.4	20.0	19.3	19.9	16.4	15.3	16.8	20.3	16.8						
11	*Boiga kraepelini*	17.8	18.0	17.4	17.6	19.2	18.7	19.1	18.7	17.8	17.7					
12	*Boiga multomaculata*	15.0	15.3	19.5	14.1	18.4	20.4	20.2	14.3	18.4	18.3	17.3				
13	*Boiga ocellata*	17.9	21.1	18.7	19.0	15.2	16.6	15.7	20.1	15.8	17.5	18.8	18.5			
14	*Boiga thackerayi* **sp. nov.**	11.1	15.9	18.9	15.8	19.3	20.6	20.0	13.4	19.1	20.2	17.4	14.8	19.4		
15	*Boiga trigonata*	14.0	14.4	18.0	14.2	19.0	19.1	19.3	14.3	17.4	18.3	17.7	13.0	19.1	15.6	
16	*Boiga westermanni*	20.1	19.5	16.5	18.7	17.9	22.7	17.9	19.5	19.3	15.1	17.6	15.4	20.4	17.0	18.1

throughout, slightly flatter ventrally, widest at midbody, distinctly tapering anteriorly and posteriorly. Head broader than high (HW/HL1 ratio 1.39), much wider than neck. In dorsal view, head ovate, from posterior margin sides mildly convex till posterior of orbit, sharply converging anteriorly in front of eye. Front of snout slightly rounded when viewed dorsally. Shields on top of head juxtaposed and not imbricate (Fig. 2a).

In dorsal view, rostral marginally visible, projects beyond tip of lower jaw when viewed from below (Fig. 2b); wider (3.3 mm) than high (2 mm). Frontal pentagonal with straight anterior margin, longer (5 mm) than wide (3.7 mm), lateral edges anteriorly diverging; shorter (FL/PL ratio 0.75) and narrower (FW/PW ratio 0.78) than parietal, slightly shorter than distance between it and snout tip. Prefrontals paired, more or less quadrangular when viewed dorsally but with a slightly sigmoid posterior margin, which is evident when viewed laterally (Figs 2c, d). Internasals paired, approximately rectangular, distinctly smaller than prefrontals. Nasals squarish, completely divided, ventral and dorsal edge slightly notched at the point of division, larger than loreal. Single loreal, squarish with slightly rounded posterior margin. Single supraocular on each side, roughly triangular when viewed from above, distinctly broader posteriorly with convex posterior margin, similar in length as frontal, in contact with prefrontal anteriorly. Preocular single, much higher than broad, with wavy anterior margin, barely reaching upper surface of head and not touching frontal. External nares distinct, rounded, between anterior and posterior nasal, laterally oriented, not visible dorsally.

Eight supralabials on each side, 1st smallest, 6th largest; SL1 in contact with rostral and nasal, SL2 touching nasal, loreal and preocular, SL3 in contact with preocular, SL6 touching lower postocular, lower anterior and posterior temporals, SL7 in contact with lower posterior temporal and scales behind posterior temporals; SL3–SL5 in contact with ocular. Eye lateral, large, eye diameter slightly less than eye to snout distance (OD/ES ratio 0.75).

Temporals 2+3 on both sides; 2 anterior temporals behind postoculars; 3 posterior temporals behind anterior temporals, which are posteriorly bordered by 4 scales on right and 3 on left side. Parietals larger, much wider (5.0 mm) and longer (6.8 mm) than other head scales. Midline interparietal suture slightly shorter (5.0 mm) than frontal (5.4 mm). Each parietal anteriorly contacts frontal, supraocular, upper postocular; laterally contacts upper temporals and one large scale; posteriorly in contact with three smaller scales. Both parietals slightly rounded posteriorly. Mouth pale inside. Teeth partially visible.

Mental small, subtriangular, much wider (3.1 mm) than long (1.6 mm). Infralabials (ILs) 10 on each side; IL1 more elongated than the rest and in strong midline contact; IL2

Fig. 1: Holotype of *Boiga thackerayi* sp. nov. (BNHS 3569) preserved specimen in (a) dorsal and (b) ventral view. Scale bar 10 mm

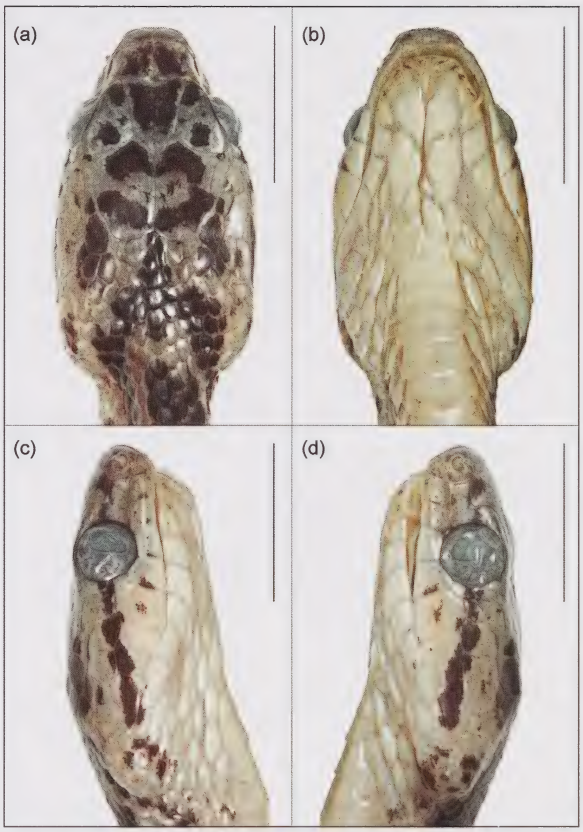

Fig. 2: Holotype of *Boiga thackerayi* sp. nov. (BNHS 3569) head of preserved specimen in (a) dorsal, (b) ventral, (c) right lateral and (d) left lateral view. Scale bar 10 mm

smallest on both sides; IL 6 largest on both sides; IL8, IL9 and IL10 longer than broad. Two pairs of genials; second pair slightly longer than first on right side; subequal on left side; both longer than broad; first pair in long midline contact; second pair anteriorly in midline contact, posteriorly separated by three elongated gular scales. Anterior genials touching IL1–4 on both sides; posterior genials contact IL 4–6.

Body and tail scales smooth, no keels or apical pits. Vertebral scale row differs from other DSRs in being relatively broader and with rounded posterior margins. Dorsal scale rows becoming smaller and more pointed laterally; all scales generally even-sized, except those close to vent which are slightly smaller, scales at anterior end of body smallest. Ventrals broad, slightly angulate laterally, 221; anal single. Dorsal scale rows 19 at the level of first ventral, reducing to 17 by merging of row 8 or 9 at level of ventral 132 (right) and ventral 130 (left), reducing to 15 by merging of row 2 or 3 at level of 145 ventrals on both sides; 15 rows maintained up to the vent. Tail laterally compressed, flattened ventrally. Subcaudals paired, 101, terminal scute pointed.

Hemipenis simple, spinous throughout except apex. Sulcus spermaticus simple, oblique. Spines at the base relatively larger than the ones on top. Spines arranged in whorl-like pattern. Apex nude.

Coloration (in preservative): Dorsum uniformly brownish throughout with 72 indistinct dark bands on body and 37 on tail (Fig. 1). Bands much broader on dorsal aspect, becoming thin and indistinct laterally; bands towards head slightly distinct laterally. Bands uniformly darker from head till 10th band, posteriorly vertebral scale row and a few adjacent dorsal scales with pale speckles or similar coloured posterior borders, most prominent at midbody. Bands on anterior aspect of tail appear merged / indistinct / zigzag, becoming more distinct posteriorly. Dorsal aspect of head highly pigmented; ground colour pale brown except greyish interorbital region; internasal and prefrontal speckled with dark brown colour; frontal almost entirely speckled with dark brown except thin anterior and lateral borders and thick posterior aspect greyish; each supraocular with light brown

Table 3: Meristic and morphometric data (in millimetres) for the type series of *Boiga thackerayi* sp. nov.

Specimen number	BNHS 3569 Holotype	BNHS 3570 Paratype	BNHS 3571 Paratype
Sex	M	F	F
Snout to Vent length	870	493	552
Tail length	293	181	157
Head length (from tip of snout to posterior edge of lower jaw)	17.4	13.4	12.9
Head length (from tip of snout to posterior edge of parietals)	14.3	11.7	11.7
Head width	11.7	9.2	9.2
Head height	8.4	5.8	5.4
Eye diameter	4.1	3.5	3.8
Eye to snout length	5.7	4.4	4.2
Width of vertebral scale at midbody	4.1	2.8	2.8
Length of vertebral scale at midbody	4.3	4.1	5.2
Width of paravertebral scale row bordering the vertebral scale row	2.8	1.9	2.2
Length of paravertebral scale row bordering the vertebral scale row	4.4	3.8	2.6
Loreal width	1.3	1.0	0.9
Loreal height	1.6	1.1	1.0
Preocular width	2.8	2.4	2.2
Preocular length	1	0.8	0.8
Temporals - anterior	2	2	2
Temporals - posterior	3	5	3
Dorsal scale rows	19/17/15	19/19/15	19/17/15
Ventrals	221	211	212
Preventrals	3	3	3
Subcaudals	101	100	93
Supralabials (Left/Right)	8/8	8/8	8/8

speckles and a pair of much darker blotches on anterior and mid-posterior aspect, a much smaller similar coloured blotch at mid-lateral position, close to frontal; each parietal with a pair of thick, dark bands covering anteromedial and posterior aspects, marginally touching each other laterally on right and distinctly separate on left; anterior bands roughly crescentic, touching each other medially behind frontal, posterior bands continue on posterolateral aspect in two to three rows of adjacent scales. A thick, dark brown, chevron-shaped band starting behind parietal juncture, with each arm continuing on either side of the nuchal region. Lateral aspect of head off-white, all scales distinctly peppered with pale brown dots, except ventral margin of SL 3–7 and IL 4–9 off white; additionally, nasal, loreal, SL 1–6 with dark brown mottling. A thin dark stripe starts on preocular, extending as a thick, uneven, postocular stripe on juncture of postoculars, through more than half of lower temporals, diagonally through upper edge of 7th supralabial and lower half of 8th supralabial, ending at angle of jaw, precisely on 8th supralabial. Venter off-white to yellowish, intermixed with prominent patterns throughout; anterior aspect unspeckled with distantly spaced small dark spots on either side of ventrals; posterior aspect deeply speckled with more closely spaced, larger, dark spots with indistinct off-white border on either side of ventrals. Speckling and size of lateral spots gradually increasing posteriorly; tail deeply speckled throughout. Head ventrally entirely off-white, except mental and IL 1–3 distinctly peppered with pale brown dots and dark brown mottling.

Coloration (in life): Overall coloration similar to that in preservation, except dorsum brownish with bands much darker (Fig. 3a). Head and most of the anterior aspect of

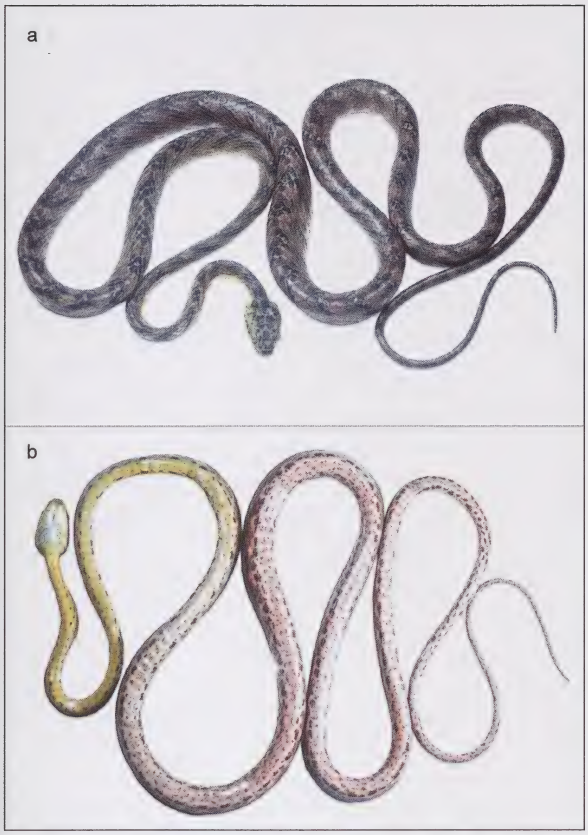

Fig. 3: Holotype of *Boiga thackerayi* sp. nov. (BNHS 3569) showing colour in life: a) dorsal and b) ventral view

Fig. 4: *Boiga thackerayi* sp. nov. in life: a) Adult holotype in natural habitat (BNHS 3569) and b) Juvenile specimen from Koyna (not collected)

the body distinctly yellowish, gradually becoming pinkish posteriorly, except head venter which is white with yellow border (Fig. 3b). The indistinct border around dark spots on either side of ventrals is also yellowish to pale pink in life. A single juvenile observed has similar colours, except the dorsum pale brown throughout with no yellow (Fig. 4b).

Variation and additional information from paratypes: Meristic and morphometric data is given in Table 3. Paratypes match with holotype in all aspects except a few variations in size, mainly due to way the specimens are preserved. In specimen BNHS 3570, dorsal scales in 19/19/15 rows; dorsal scales on anterior aspects heterogenous with vertebral scale row at many places not significantly enlarged; dorsal scale rows 19 at the beginning reducing to 17 by level of 51st ventral, reducing to 15 by level of 143rd ventral.

Etymology: The specific epithet is an eponym honouring Mr Tejas Thackeray for his work on freshwater crabs of the Western Ghats. He also collected the type series of this new species and is a strong supporter of many ongoing research projects on herpetofauna in India.

Suggested English common name: Thackeray's Cat Snake.

Differences between *Boiga thackerayi* sp. nov. and South Asian congeners

The number of dorsal scale rows (19:19–17:15) of *Boiga thackerayi* sp. nov. can be easily used to distinguish it from 11 of its congeners, namely *B. andamanensis*, *B. cyanea*, *B. dightoni*, *B. forsteni*, *B. gokool*, *B. multifasciata*, *B. nuchalis*, *B. ochracea stoliczkae*, *B. siamensis*, *B. trigonata*, *B. wallachi*, all of which have 21 or more scale rows at midbody.

Though *Boiga thackerayi* sp. nov. shares dorsal scale rows (19:19–17:15) with *B. barnesii*, *B. beddomei*, *B. ceylonensis*, *B. flaviviridis*, *B. multomaculata*, *B. ochracea*, and *B. quincunciata*, all of which can have 19 scale rows at midbody, it differs in the combination of number of ventral

Table 4: Variation in scalation among *Boiga* spp. with 19 DSR from India and Sri Lanka

Species	Ventrals	Subcaudals	Preoculars	Coloration	Distribution in India
Boiga thackerayi sp. nov.	211–221	94–102	1	Dorsum with 70–72 indistinct dark bands, belly with few dark speckles intermixed with a series of distinct dark spots on lateral edges of ventrals.	NWG
Boiga barnesii	208–220	96–120	3	Dorsum with 30–35 saddle-like dark blotches, belly densely speckled with brown dots.	Sri Lanka
Boiga beddomei	246–266	111–133	1	Dorsum with 70–98 dark, wide vertebral bands, fading posteriorly, belly sparsely speckled with dark spots and a series of a few dark lateral spots	WG and Sri Lanka
Boiga ceylonensis	209–243	91–112	1	Dorsum with 60–76 dark, wide vertebral bands, fading posteriorly, belly with small, dark, dense speckling and a series of lateral dark spots.	WG and Sri Lanka
Boiga flaviviridis	248–259	106–109	1	Dorsum with about 90 faint, hardly visible dark bands on yellowish-green ground colour, belly uniformly cream coloured.	Eastern Peninsular India
Boiga multomaculata	192–251	72–109	1, rarely 2	Dorsum with two rows of alternating large rounded blackish-brown and light edged blotches, lateral with a series of irregular dark markings, belly with 2–3 small dark angular spots on each ventral.	Northeast India
Boiga ochracea ochracea	221–252	89–119	1	Dorsum uniformly reddish-brown, belly uniformly cream.	Northeast India
Boiga quincunciata	237–253	118–125	1	Dorsum with light-bordered blackish irregular vertebral blotches, alternating with irregular, short, dark brown lateral bands or blotches, belly densely speckled with fine brown dots.	Northeast India

and subcaudal scales, colour pattern, and distribution (see Table 4).

Distribution, natural history, and conservation: Presently *Boiga thackerayi* sp. nov. is only known from its type locality near Humbarli, Koyna in Satara district. The specimens were seen close to a perennial stream in a semi-evergreen patch of forest (Fig. 4a). A few more individuals were observed in other similar streams, close to the type locality. This species may occur in nearby Chandoli National Park, but further investigations and intensive surveys need to be conducted to record its distribution. All individuals were observed on trees, close to the forest streams (Fig. 5), and were seen to be active during the night. A single uncollected individual temporarily kept alive in captivity for observation refused to feed on terrestrial, aquatic, or burrowing frogs of the genera *Minervarya* Dubois, Ohler, and Biju, 2001; *Euphlyctis* Fitzinger, 1843; and *Sphaerotheca* Günther, 1859 respectively, or on geckos. This individual readily accepted frogs which are good climbers, like *Indirana* sp., *Raorchestes* cf. *ghatei*, and *Pseudophilatus* sp. *Boiga* sp. (now identified as *Boiga thackerayi* sp. nov.) has also been observed feeding on eggs of *Nyctibatrachus humayuni* (see Willaert *et al.* 2016: supplemental information video S10). This is, to the best of our knowledge, the first report of predation on anuran eggs by a *Boiga* species (Alford 1999; Green 1989).

The type locality is situated in Sahyadri Tiger Reserve, a large national park, which is a well-protected area. No immediate threats are observed in the type locality.

DISCUSSION

Of the 34 species of *Boiga* currently regarded as valid, 16 are known from India and five from Sri Lanka (Uetz *et al.* 2019). *Boiga thackerayi* sp. nov. is the second species endemic to the Western Ghats after *B. dightoni*; the only known endemic species from Sri Lanka is *B. barnesii*. All three species have a restricted distribution with their respective type localities in the wet zones of India and Sri Lanka. *Boiga beddomei*, *B. ceylonensis*, *B. forsteni*, and *B. trigonata* are the other species reported from both countries. *Boiga forsteni* and

Fig. 5: Habitat of *Boiga thackerayi* sp. nov. in a perennial stream during the monsoon at Humbarli, Koyna in Satara district, Maharashtra

B. trigonata are considerably widely distributed and are also known from open, arid to semi-arid habitats (Mohapatra *et al.* 2010). The most common and "widely distributed" species mainly across wet zones in the Western Ghats and Sri Lanka are *Boiga beddomei* and *B. ceylonensis* (Vogel and Ganesh 2013; Whitaker and Captain 2004).

It is evident, based on studies across various taxa, that most of the faunal elements in Sri Lanka are subsets of Indian fauna (Biswas and Pawar 2006; Bossuyt *et al.* 2004; Lajmi *et al.* 2018). Although, endemism is high in wet zones (Lajmi *et al.* 2018; Roelants *et al.* 2004) and in the dry zones of India and Sri Lanka, there are shared faunal elements (Guptha *et al.* 2015; Lajmi *et al.* 2018; Pearson and Ghorpade 1989; Ripley and Beehler 1990). In view of the distinctiveness of the wet zone elements in India and Sri Lanka (Bossuyt *et al.* 2004), it is likely that most of the *Boiga* with 19 midbody scale rows from the Western Ghats could be distinct lineages that have been systematically incorrectly assigned. An example is the recently described *Boiga flaviviridis* from Eastern Peninsular India (Vogel and Ganesh 2013), a taxon which was formerly misidentified as *Boiga beddomei* (see Sivakumar and Manakadan 2007).

Although *Boiga* spp. are common across their range in the Western Ghats, they are poorly studied and most of their identifications are based on morphological characters (Smith 1943; Whitaker and Captain 2004). There is a need to systematically assess all the populations of *Boiga*, especially those considered as *B. ceylonensis* and *B. beddomei* from India, using an integrated approach. With *Boiga thackerayi* sp. nov., we have described a distinct lineage, which is morphologically similar to *B. ceylonensis*, highlighting the importance of such cryptic diversity. All the known species of *Boiga* from the Western Ghats are arboreal and feed on frogs, lizards, birds, and small mammals (pers. obs.). This new species shows unique feeding behaviour, exclusively eating climbing frogs and opportunistically frog eggs, which was not reported earlier in this genus. The only known obligate oviphagous snake from India was *Boiga westermanni*. This species was until recently included in a monotypic genus *Elachistodon* due to its feeding behaviour and associated morphological characters. But, based on its phylogenetic relationship, it is assigned to *Boiga* (Mohan *et al.* 2018), a genus of snakes where egg-eating was never documented. Feeding on eggs of *Nyctibatrachus humayuni* (Willaert *et al.* 2016) by *Boiga thackerayi* sp. nov. appears to be opportunistic. These frogs are also endemic to the northern Western Ghats and are observed in and around forest streams, where they lay eggs on overhanging trees or rocks. These eggs appear to be a good resource for the arboreal *B. thackerayi* sp. nov. during monsoon. Further studies on the ecology of this new species of snake are warranted.

In recent years, two new species of snakes, *Melanophidium khairei* Gower *et al.* 2016 and *Rhabdops aquaticus* Giri *et al.* 2017 were described from the northern Western Ghats (Giri *et al.* 2017; Gower *et al.* 2016). Both these species were 'misidentified' as previously known species, *Melanophidium punctatum* Beddome, 1871 and *Rhabdops olivaceus* (Beddome, 1863), respectively. A detailed morphological study of all known species of *Melanophidium* and an evaluation of the phylogenetic position of various populations of *Rhabdops* from the Western Ghats proved the distinctiveness of these two northern Western Ghats species. The description of *Boiga thackerayi* sp. nov. not only highlights the importance of this landscape but the necessity for an integrated approach in species identification as well.

ACKNOWLEDGEMENTS

We thank Dhananjay Jadhav, Sameer Kehimkar, Shankar Desai, Vaibhav Patil, Sanjay Patil, and Vijay Sandge for their valuable assistance during the field work. We extend our gratitude to the Forest Department, Maharashtra; Shree Bhagwan, former PCCF, Maharashtra; Panditrao, DFO, Santosh Sate, DFO, Puranik, ACF, and Santosh Chalke for granting us permission to collect specimens and to conduct field surveys. Thanks to Rahul Khot, Curator, BNHS Collections, for his assistance in depositing specimens at the Bombay Natural History Society. For permanent support with loan of specimens under their care, we are very grateful to Colin McCarthy and Patrick Campbell (BMNH London, UK), Jens Vindum (CAS, San Francisco, USA), Alan Resetar (FMNH Chicago, USA) José Rosado (MCZ Cambridge, USA), and Jakob Hallermann (ZMH, Hamburg, Germany).

DV thanks Praveen Karanth for lab support. We thank Ishan Agarwal, Chaitanya R., and Akshay Khandekar for valuable discussions and Mendis Wickramsinghe for images of live specimens of *Boiga ceylonensis*.

REFERENCES

Agarwal, I., S. Biswas, A.M. Bauer, E. Greenbaum, T.R. Jackman, A.D. Silva & S. Batuwita (2017): Cryptic species, taxonomic inflation, or a bit of both? New species phenomenon in Sri Lanka as suggested by a phylogeny of dwarf geckos (Reptilia, Squamata, Gekkonidae, *Cnemaspis*). *Systematics and Biodiversity 1–13*: doi: 10.1080/14772000.2017.1282553.

Alford, R.A. (1999): Ecology. Resource use, competition and predation. Pp. 240–278. *In*: McDiarmid, R.W. & R. Altig (Eds): Tadpoles. The Biology of Anuran Larvae. The University of Chicago Press, Chicago and London, xiv + 444 pp.

Biswas, S. (2008): Did biotic impoverishment facilitate phenomenal diversification in Sri Lanka? *Current Science 95(8)*: 1021–1025.

Biswas, S. & S.S. Pawar (2006): Phylogenetic tests of distribution patterns in South Asia: Towards an integrative approach. *Journal of Biosciences 31*: 95–113.

Bossuyt, F., M. Meegaskumbura, N. Beenaerts, D.J. Gower, R. Pethiyagoda, K. Roelants, A. Mannaert, M. Wilkinson, M.M. Bahir, K. Manamendra-Arachchi, P.K. Ng, C.J. Schneider, O.V. Oommen & M.C. Milinkovitch (2004): Local endemism within the Western Ghats-Sri Lanka biodiversity hotspot. *Science 306*: 479–481.

Burbrink, F.T., R. Lawson & J.B. Slowinski (2000): Mitochondrial DNA phylogeography of the polytypic North American rat snake (*Elaphe obsoleta*): a critique of the subspecies concept. *Evolution 54*: 2107–2118.

Das, A., P.P. Mohapatra, J. Purkayastha, S. Sengupta, S.K. Dutta, M.F. Ahmed & F. Tillack (2010): A contribution to *Boiga gokool* (Gray, 1835) (Reptilia: Squamata: Colubridae). *Russian Journal of Herpetology 17(3)*: 161–178.

Dowling, H.G. (1951a): A proposed standard system of counting ventrals in snakes. *British Journal of Herpetology. 1*: 97–99.

Dowling, H.G. (1951b): A proposed method of expressing scale reductions in snakes. *Copeia 2*: 131–134.

Dowling, H.G. & J.M. Savage (1960): A guide to the snake hemipenis: a survey of basic structure and systematic characteristics. *Zoologica 45*: 17–31.

Figueroa, A., A.D. Mckelvy, L.L. Grismer, C.D. Bell & S.P. Lailvaux (2016): A species-level phylogeny of extant snakes with description of a new colubrid subfamily and genus. *PLoS ONE 11(9)*: doi: e0161070. https://doi.org/10.1371/journal.pone.0161070.

Giri, V.B., V. Deepak, A. Captain, A. Das, S. Das, K.P. Rajkumar, R.L. Rathish & D. Gower (2017): A new species of *Rhabdops* Boulenger, 1893 (Serpentes : Natricinae) from the northern Western Ghats region of India. *Zootaxa 4539(1)*: 27–52.

Gower, D.J., V.B. Giri, A. Captain & M. Wilkinson (2016): A reassessment of *Melanophidium* Günther, 1864 (Squamata. Serpentes. Uropeltidae) from the Western Ghats of peninsular India, with the description of a new species. *Zootaxa 4085(4)*: 481–503.

Green, H.W. (1989): Ecological, evolutionary, and conservation implications of feeding biology in Old World cat snakes, genus *Boiga* (Colubridae). *Proceedings of the California Academy of Sciences 46(8)*: 193–207.

Guptha, B., N.V.S. Prasad, S.T. Maddock & V. Deepak (2015): First record of *Chrysopelea taprobanica* Smith, 1943 (Squamata: Colubridae) from India. *Check List 11*: 1523.

Kroon, C. (1973): A new colubrid snake (*Boiga*) from southeastern Asia. *Copeia 3*: 580–586.

Lajmi, A., R. Bansal, V. Giri & P. Karanth (2018): Phylogeny and biogeography of the endemic *Hemidactylus* geckos of the Indian subregion suggest multiple dispersals from Peninsular India to Sri Lanka. *Zoological Journal of the Linnean Society XX*: 1–16.

Mohan, A.V., A.C. Visvanathan & K. Vasudevan (2018): Phylogeny and conservation status of the Indian egg-eater snake, *Elachistodon westermanni* Reinhardt, 1863 (Serpentes, Colubridae). *Amphibia-Reptilia*. doi: 10.1163/15685381-17000201.

Mohapatra, P.P., A. Das, F. Tillack & S.K. Dutta (2010): Taxonomy, natural history, and distribution of *Boiga forsteni* (Duméril, Bibron et Duméril, 1854) (Serpentes: Colubridae) from Orissa, India. *Russian Journal of Herpetology 16(4)*: 243–252.

Palumbi, S.R. (1996): Nucleic acids II: the polymerase chain reaction. Pp. 205–247. *In*: Hillis, D.M., C. Moritz, and B.K. Mable (Eds): *Molecular Systematics*, 2nd edn. Sinauer, Sunderland, Massachusetts.

Pearson, D.L. & K. Ghorpade (1989): Geographical distribution and ecological history of tiger beetles (Coleoptera: Cicindelidae) of the Indian subcontinent. *Journal of Biogeography 1*: 333–344.

Ripley, S.D. & B.M. Beehler (1990) Patterns of speciation in Indian birds. *Journal of Biogeography 1*: 639–648.

Roelants, K., J. Jiang & F. Bossuyt (2004): Endemic ranid (Amphibia: Anura) genera in southern mountain ranges of the Indian subcontinent represent ancient frog lineages: evidence from molecular data. *Molecular Phylogenetics and Evolution 31*: 730–740.

Sabaj, H.M. (2016): Standard symbolic codes for institutional collections in herpetology and ichthyology: an Online Reference. Version 6.5 (August 16, 2016). Electronically accessible at http://www.asih.org/, American Society of Ichthyologists and Herpetologists, Washington, DC.

Sivakumar, S. & R. Manakadan (2007): Record of *Boiga beddomei* (Wall, 1909) from Sriharikota, Andhra Pradesh, India. *J. Bombay Nat. Hist. Soc. 104(1)*: 103–104.

Smith, M.A. (1943): Fauna of British India including Ceylon and Burma. Vol–III Serpentes. Taylor & Francis, London, 583 pp.

Tamura, K., D. Peterson, N. Peterson, G. Stecher, M. Nei & S. Kumar (2011): MEGA5: Molecular evolutionary genetics analysis using maximum likelihood, evolutionary distance, and maximum parsimony methods. *Molecular Biology and Evolution 28*: 2731–2739.

Thompson, J.D., D.G. Higgins & T.J. Gibson (1994): ClustalW: improving the sensitivity of progressive multiple sequence alignment through sequence weighting, position-specific gap penalties and weight matrix choice. *Nucleic Acids Research 22*: 4673–4680.

Uetz, P., P. Freed & J. Hošek (eds) (2019): The Reptile Database. Available from: http://www.reptile-database.org. Accessed on May 07, 2019.

Vogel, G. & S.R. Ganesh (2013): A new species of cat snake (Reptilia: Serpentes: Colubridae: *Boiga*) from dry forests of eastern Peninsular India. *Zootaxa 3637(2)*: 158–168.

WALL, F. (1909): Remarks on some forms of *Dipsadomorphus*. *Records of the Indian Museum 3*: 151–155.

WHITAKER, R. & A. CAPTAIN (2004): Snakes of India. The Field Guide. Draco Books, Chennai, xiv + 481 pp.

WILLAERT, B., R. SUYESH, S. GARG, V.B. GIRI, M.A. BEE & S.D. BIJU (2016): A unique and complex mating strategy without physical contact during fertilization in *Nyctibatrachus humayuni* (Anura. Nyctibatrachidae), with the description of a new form of amplexus and female advertisement call. *PeerJ 4*: doi: e2117; DOI 10.7717/peerj.2117.

Recommended Citation

Giri, Varad B., V. Deepak, Ashok Captain, Swapnil Pawar and Frank Tillack (2019): A new species of *Boiga* Fitzinger, 1826 (Serpentes: Colubridae) from the northern Western Ghats of India. *J. Bombay Nat. Hist. Soc. 116*: 71–81 . doi: 10.17087/jbnhs/2019/v116/144901

MISCELLANEOUS NOTES

1. "ASIATIC CHEETAH *ACINONYX JUBATUS VENATICUS* IN INDIA: A CHRONOLOGY OF EXTINCTION" – REACTIONS AND A CORRECTION

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[1]First published: November 30, 2019 | doi: 10.17087/jbnhs/2019/v116/148410
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Background

The paper on the chronology of the extinction of the cheetah in India (*J. Bombay Nat. Hist. Soc.* Vol. 116; first published online on July 31, 2019) has been received favourably. However, there were a few reactions and comments from readers which require the authors' response. Additionally, a correction needs to be made, hence this addendum.

Reactions and Authors' Comments

Prosenjit Das Gupta, a naturalist, scholar, and author, took note of us mentioning the import of African cheetahs into India beginning from 1918 onwards and put forth the following observation: "To what extent these African cheetahs came to be counted among the records of "coursing" cheetahs or even of "speared" cheetahs is an open question."

The authors' search has not revealed any reference to cheetahs being speared after 1918. The last such references noted in the paper are between the years 1884 and 1902. There are only two references to coursing with cheetahs after 1918, which have been included. To these the authors have assigned a total of 4 animals. The reasons for these inclusions are as below:

Firstly, Maj. Gen Nigel Woodyatt's book, with its preface dated 1922, records his memoirs of sport in the period prior to World War I. In it, he describes the method of trapping cheetahs from the wild as follows:

"What a rajah's shikaris do is to capture an adult animal. For this task they deserve much credit... It is sometime done by putting a bait in an enclosure furnished with a trap door. More often however strong nooses are set round a tree where cheetahs are known to whet their claws. When the animal is caught, he is most pluckily secured, roped, hooded and eventually – by the means of plenty of starvation – tamed." (Woodyatt 1923: pp. 162–163).

The book also has a photograph of trappers with 1 cheetah, 2 caracals *Caracal caracal* and 3 falcons/hawks for hawking (Fig. 1). Such trappers would not have an imported animal. Hence, the authors have assigned a tally of 2.

Secondly, Lt Col. H.S. Wood has recorded coursing with cheetahs in Jeypore. This is from the present day Koraput district in Odisha and not from Jaipur, Rajasthan as erroneously stated in the paper. His book was published in 1934. In it, he recounts his shikar experiences of 36 years from 1891 onwards (Wood 1934: pp. 7, 16, 291). The Jeypore cheetah reference pertains to the period prior to 1921 (during which four years from 1914 to 1918 were taken up by World War I). The authors have not come across any reference to cheetah imports in Odisha during this period or later. It is also not out of place to note here that a cheetah was shot in Kalahandi as late as 1939, as recorded in the paper (where it is

Fig. 1: Cheetah and caracals for hunting and hawks for hawking with local persons

recorded as "Orissa"). Thus, we believe the Jeypore cheetahs to be of indigenous origin and hence have included them in our table and have assigned a tally of 2.

Mr Das Gupta has also queried the reasons for the disappearance of the cheetah in Rajasthan and Gujarat before the depletion of its prey there. Such reasons are no different from those of elsewhere in the Subcontinent. Cheetahs were in severe decline from at least the 18th century. Their prey survived in abundance during this period and till much later, both in these two states and elsewhere in cheetah occurrence areas. To be able to give a specific answer for these regions would require a study of its own and in any case, the reasons for the decline of the cheetah in India are beyond the scope of this paper.

Dr Suhas Kumar, retired PCCF, Madhya Pradesh, also put across an interesting query. He noted: "I am a little intrigued by the fact that the places from where the Asiatic Cheetah were reported must have been dense woodlands in 17th–18th century and till the early part of 19th century as the [human] population density was very low and expansion of agriculture began after Independence. If that was the situation, how were cheetahs present there? As you know most grasslands in India are anthropogenic therefore I doubt that there might have been extensive grassland habitats in all those areas from where cheetahs were reported?"

The point is well made. The authors' chronology is essentially of the 19th and 20th centuries. The cheetah's most preferred habitat was grassland though they were not limited or exclusive to it, and the British period literature establishes their geographical spread across a variety of scrub, arid and semi-arid open tracts throughout most of the Indian subcontinent. Nonetheless, be that as it may, the human population in India increased exponentially from 158.92 million in 1800 to 254.51 in 1881, i.e. in a span of 80 years according to a pioneering study (Guha 2001: p. 58). Grasslands and scrub jungles were the first to be pressurized by agriculture and by the grazing needs of livestock. The cheetah's preferred habitat was, of course, grassland and scrub jungles. With the latter's depletion, cheetahs too suffered. Ultimately, they were pushed or left into their least preferred habitats on the edges of thick jungles including sal *Shorea robusta* forests or in meadows within them.

A Correction

In the paper we had concluded that there was a black cheetah as reported by Johnson Wilkinson (Wilkinson and Wilkinson 1896: pp. 99–103). The black animal is mentioned in the book's chapter on the cheetah. The relevant passage quoted in our paper starts with the description of the cheetah being pulled out from under a sofa in a drawing room of a house and ends with it. In between, this passage goes on to describe "cheetahs or leopards" destroying livestock including bullocks, dogs, etc. and hunting at night. The passage also mentions a Mouse Deer *Moschiola indica* which is not likely to be in a cheetah's favoured habitat. Dr M.K. Ranjitsinh and Mr Prosenjit Das Gupta had raised doubts regarding this reference. On close examination, the authors now conclude that the reference is to a leopard *Panthera pardus* and not to a cheetah. The error is regretted.

Raza Kazmi continues to research sources concerning the existence and distribution of the cheetah in India and the sport of coursing blackbuck with it. Since the publication of the authors' paper, he has come across several more credible references to them. We propose to present a second paper based on these findings in due course of time.

REFERENCES

Guha, Sumit (2001): Health and Population in South Asia: From Earliest Time to the Present. Permanent Black, New Delhi.

Wilkinson, Osborn & Johnson Wilkinson (1896): The Memoirs of the Gemini Generals, Personal Anecdotes, Sporting Adventures and Sketches of Distinguished Officers. A.D. Innes & Co., London.

Wood, Lt. Col. H.S. (1934): Shikar Memories: A Record of Sport and Observation in India and Burma. F.H. & G. Witherby, London.

Woodyatt, Maj. Gen. Nigel (1923): My Sporting Memories: Forty Years with Note-Book and Gun. Herbert Jenkins Ltd, London.

Recommended Citation

Divyabhanusinh and Raza Kazmi (2019): "Asiatic Cheetah *Acinonyx jubatus venaticus* in India: A chronology of extinction." – Reactions and a correction. *J. Bombay Nat. Hist. Soc. 116*: 82–83. doi: 10.17087/jbnhs/2019/v116/148410

2. PHOTOGRAPHIC RECORD OF THE GOLDEN JACKAL *CANIS AUREUS* IN PERIYAR TIGER RESERVE, KERALA[1]

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[1]Accepted: April 03, 2019
First published: October 31, 2019 | doi: 10.17087/jbnhs/2019/v116/142784
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On January 09, 2019, while documenting birds in Periyar Tiger Reserve, along a canal that supplies water to Tamil Nadu, the first author spotted a Golden Jackal *Canis aureus* approaching the canal from the opposite bank. The jackal was seen in the area for some time and it was photographed by the second author (Fig. 1). This observation represents the first photographic evidence of Golden Jackal from Periyar Tiger Reserve. Though the species has been listed in the Tiger Conservation Plan (TCP 2011–2022), a study in the reserve during 1977–82 did not report its occurrence (Nair *et al.* 1985). According to Mannan tribesmen, they used to see this jackal some years ago, but not in recent times. According to them, the jackals used to dig up corpses and feed on them. Digging out corpses has also been reported earlier (Sterndale 1990). It is difficult to tell from where the jackal may have come to Periyar Tiger Reserve. It may possibly have been attracted by the presence of wild kills in the Reserve.

Fig. 1: *Canis aureus* photographed in Periyar Tiger Reserve

In India, the species is widely distributed (Jhala and Moehlman 2013). However, the population has declined in certain parts of the country due to land use change (Pillay *et al.* 2011). Wanton killing and killing for its pelt would also have contributed to its decline. A recent survey (2016–17) in the Periyar-Agasthyamalai landscape (southern part of Kerala) by the staff of Periyar Tiger Conservation Foundation, despite the use of camera traps and search for direct and indirect evidences, did not record the species. This shows the animal's rarity in the landscape. Hence, the sighting of the jackal in a landscape where it has not been reported in recent years becomes significant. The jackal has been reported from northern Kerala with two viable populations in Kannur and Calicut (Shameer 2017).

The species is in the Least Concern category of IUCN Red List due to habitat versatility, range expansion, and limited threats throughout its global range (Hoffman *et al.* 2018). However, within the country in spite of its widespread distribution, the species faces persecution from humans, and population decline due to factors such as habitat loss (Negi 2014), wanton killing, and poaching. These factors should be kept in mind to safeguard the future of this canid.

REFERENCES

Hoffmann, M., J. Arnold, J.W. Duckworth, Y. Jhala, J.F. Kamler & M. Krofel (2018): *Canis aureus*. The IUCN Red List of Threatened Species 2018. Downloaded on January 28, 2019.

Jhala, Y.V. & D. Moehlman (2013): Golden Jackal. Pp. 366–376. *In*: Mammals of South Asia. (Eds: Johnsingh, A.J.T. & N. Manjrekar), Vol. 1. Universities Press, Hyderabad. 614 pp.

Nair, P.V., K.K. Ramachandran, V.S. Vijayan, P.S. Easa & P.V. Balakrishnan (1985): An ecological study in Periyar Tiger Reserve with special reference to wildlife. KFRI Research Report 24. 159 pp.

Negi, T. (2014): Review on current worldwide status, distribution, ecology and dietary habits of Golden Jackal *Canis aureus*. *Octa Journal of Environmental Research 2(4)*: 338–359.

Pillay, R., A.J.T. Johnsingh, R. Raghunath & M.D. Madhusudhan (2011): Patterns of spatiotemporal change in large mammal distribution and abundance in the southern Western Ghats, India.

Biological Conservation 144: 1567–1576.

SHAMEER, T.T. (2017): Occupancy and spatial distribution of lesser cats, civets and jackals of southern Western Ghats. PhD Thesis. Bharathiar University.

STERNDALE, R.A. (1990): Natural History of the Mammalia of India and Ceylon. Reprint. Royal Publications, Calcutta. 540 pp.

Recommended Citation

David, J. Patrick, A. Rajkumar, Ramesh Babu, Silpa V. Kumar, and Georgi Mathachan (2019): Photographic record of the Golden Jackal *Canis aureus* in Periyar Tiger Reserve, Kerala. *J. Bombay Nat. Hist. Soc. 116*: 84–85. doi: 10.17087/jbnhs/2019/v116/142784

3. ARE THE "RICE-EATING JACKALS" OF RANN OF KACHCHH GONE?[1]

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[1]Accepted July 04, 2019
First published: December 31, 2019 | doi: 10.17087/jbnhs/2019/v116/145219
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Golden Jackal *Canis aureus*, an omnivorous canid, is known to be a human commensal (Jhala and Moehlman 2013). Mostly living in pairs, they can temporarily meet for social gatherings (van Lawick and Goodall 1970) or can be found in territorial groups (Macdonald 1979), depending upon resource availability.

Dattatreya temple at Kala Dungar is situated at the highest elevation in Kachchh (462 m), India, and is known to harbour a high density of jackals (Menon 2012). For ages, the temple authorities have been ritually feeding rice (8 kg) and cane sugar (4 kg) at each meal (Agoramoorthy *et al.* 2011) to the jackals before it is served as *prasad* to the people. Owing to a free but clumped food resource, *c.* 26 jackals were reported to gather twice a day to feed on the *prasad* (Agoramoorthy *et al.* 2011).

During a survey in June 2016, one jackal was encountered twice out of three occasions. An "occasion" is defined here as one *prasad* feeding session. On both these occasions, the jackal displayed vigilant behaviour, which was most likely in response to Wild Pigs *Sus scrofa* that now seem to be dominating the area. Table 1 shows the animals observed at the feeding platform.

Maldharis, who are tribal herdsmen living in the nearby forest, were interviewed. They reported that jackals are rare now, with the last case of attack on a sheep in the year 2004–2005. Loss of vigilance behaviour in sheep was also used as an indicator of decline in numbers of predators in this area by the tribesmen.

Table 1: Mammalian species visiting the platform and time spent on three occasions

Species	No. of individuals	Time spent (mins)	No. of occasions present
Golden Jackal *Canis aureus*	1	4	2
Wild Pig *Sus scrofa*	13 (1 male, 5 subadult, 1 female, 6 stripers)	7.04	4
Grey Mongoose *Herpestes edwardsii*	3	40	2
Domestic Dog *Canis lupus familiaris*	1	-	1
Feral Cat *Felis catus*	1	-	1

The trustees of Dattatreya temple mentioned that jackals were being fed since years before Independence 1947. They mentioned that the temple was a small building, without electricity and with minimal tourist disturbance. However, after a major earthquake hit Gujarat in 2003, facilities such as electricity were provided. The temple was renovated and more area was given to it. They mentioned that jackal numbers started to decline since then. This was also the time when wild pigs and dogs appeared, and tourist pressure increased. Even today, the locals report only 2–4 jackals that come to feed. Although the reason is not clear, it is obvious that jackals have declined around Kala Dungar.

REFERENCES

AGORAMOORTHY, G., V.V. KUMAR & P. PATEL (2011): Rice-eating jackals of the Rann of Kachchh. *Curr. Sci. 101(7)*: 828.

JHALA, Y.V. & P.D. MOEHLMAN (2013): Golden Jackal. *In*: Mammals of South Asia (Eds: Johnsingh, A.J.T. and N. Manjrekar). Universities Press, India, pp. 366–376.

MACDONALD, D.W. (1979): The flexible social system of the golden jackal *Canis aureus*. *Behav. Ecol. Sociobiol. 5(1)*: 17–38.

MENON, G. (2012): The Jackals of Kala Dungar – Where a

community has kept them alive with vegetarian food. <https://www.thebetterindia.com/5163/the-jackals-of-kala-dungar-where-a-community-has-kept-them-alive/;> Accessed on June 10, 2019.

VAN LAWICK, H. & J. GOODALL (1970): Golden Jackals. *In*: Innocent Killers, Harper Collins, Ballantine, New York, pp. 137–194.

Recommended Citation

Srivastava, Nimisha (2019): Are the "Rice-eating jackals" of Rann of Kachchh gone? *J. Bombay Nat. Hist. Soc. 116*: 85–86. doi: 10.17087/jbnhs/2019/v116/145219

4. SIGHTING OF A YELLOW-THROATED MARTEN *MARTES FLAVIGULA* IN HUMAN DOMINATED LANDSCAPE OF NORTHEASTERN BANGLADESH[1]

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[1]Accepted May 15, 2019
First published: September 30, 2019 | doi: 10.17087/jbnhs/2019/v116/140983
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The Yellow-throated Marten *Martes flavigula* is the only living species of the genus *Martes* found in subtropical and tropical forests (Harrison *et al.* 2004). It is a wide ranging carnivore distributed from Pakistan and Afghanistan in the west to the Russian Far East and Indonesia in the east (Corbett and Hill 1992). Despite its extensive geographical range, the ecology and behaviour of this species has so far received little attention, aside from a study of habitat use (Grassman *et al.* 2005). The species inhabits a broad variety of bioclimatic zones and habitats ranging from mixed evergreen (Duckworth 1997; Grassman *et al.* 2005; Hon *et al.* 2016), deciduous and degraded forest (Datta *et al.* 2008), to upper temperate (Appel and Khatiwada 2014), subalpine forest (Mallick 2013), and scrublands (Appel and Khatiwada 2014; Duckworth 1997). It is often recorded along rivers (Datta *et al.* 2008; Duckworth 1997; Mallick 2013; Sathyakumar *et al.* 2011; Zaw *et al.* 2008). In Bangladesh, the marten has been recently discovered and its distribution is still unclear. The species is thought to occur in mixed evergreen forests of northeastern and southeastern Bangladesh (Chutipong *et al.* 2016). There are confirmed records only in Greater Sylhet division of northeast Bangladesh (IUCN Bangladesh 2015). In northeastern Bangladesh, it is found in less than 10 locations, occupying an area of 505 sq. km (IUCN Bangladesh 2015). There is no quantitative data on the total population of the species in Bangladesh. The species is threatened by ongoing degradation of habitat quality due to overexploitation of resources and expansion of betel leaf cultivation, therefore, the species has been categorized as Vulnerable in Bangladesh (IUCN Bangladesh 2015). Here we have documented the Yellow-throated Marten in human dominated area adjacent to Lawachra National Park (LNP).

We encountered a Yellow-throated Marten in HEED Bangladesh guest house (24° 20′ 20.9″ N, 91° 49′ 25.3″ E) located in Kamalganj Upazila, Maulvibazar district in the northeastern region of the country. The day was sunny with 32° C temperature and 85% humidity. The topography of the Kamalganj HEED Bangladesh is undulating with slopes and hillocks, locally called *tila*, ranging from 10–50 m height. HEED Bangladesh covers 77 hectares, consisting of 20 to 25 hillocks, small cottages (rest house), and some staff quarters. Rest houses are situated on top of the hillock enclosed by various flora. About 25 tree species are present in HEED guest house.

We have been studying the population status of Bengal Slow Loris *Nycticebus bengalensis* and some small carnivores since April 2015 in northeastern forests of Bangladesh, following 'spotlight eye-shine' method (Nekaris *et al.* 2008). As a part of our regular survey, we reached LNP on August 15, 2017. When we were birding outside the room in HEED Bangladesh guest house, suddenly we noticed movement in the top of the bushes. And for the first time at 12:45 hrs, we saw a Yellow-throated Marten leap out from the bush and run onto a medium sized branch of a Jackfruit tree *Artocarpus heterophyllus* (Fig. 1). The tree was about 17 m in height, and we observed the animal from 15 m (perpendicular distance) away. The marten was moving very fast, climbing from one

Fig. 1: Yellow-throated Marten *Martes flavigula* on *Artocarpus heterophyllus*

tree to another. In about 5 minutes of our observations, it moved across three jackfruit trees, one *Ficus* sp. tree, one Teak *Tectona grandis*, and once on the ground. Most of its foraging time, the Marten used the middle canopy. In this time period, we were able to take only three photographs. Observation was difficult because we were observing the Marten from the top of a hillock and it was foraging on trees in the ravine. After about 5 minutes, it hid itself in another bush.

The occurrence of Yellow-throated Marten in a human dominated area like HEED guest house could be possible because of its preferred habitat types and food availability. HEED is enclosed by about 25 tree species, grassland, dense bush, and undergrowth where martens can hide easily. Mallick (2013) states that Yellow-throated Marten is mostly diurnal in undisturbed forests, but becomes nocturnal near human habitations. However, we encountered it in a human dominated area during midday, hence the choice of diurnal and nocturnal behaviour might be opportunistic. Since April 2015, we have been surveying Satchari National Park (SNP) and LNP at night, but no martens were encountered during our survey period in the main protected forest. As Yellow-throated Marten has recently been discovered in Bangladesh, no quantitative data is available on its population status and ecology in Bangladesh. It was not assessed by IUCN in 2000 in Bangladesh (IUCN Bangladesh 2015). The species has been categorized as Vulnerable in Bangladesh (IUCN Bangladesh 2015) due to habitat destruction and population degradation. Globally, the total number of individuals is declining (Chutipong *et al.* 2016). So proper research and documentation of incidental records and studies on population status, ecology, and threats are needed, which would greatly improve our understanding of the species' distribution, ecology, and conservation status in Bangladesh.

ACKNOWLEDGEMENTS

We thank the Forest Department of Bangladesh for permission to carry out the study. The authors are highly thankful to Professor Dr Abdul Alim, Chairman, Department of Zoology, Jagannath University, for his support. We are also thankful to HEED Bangladesh for their valuable information. This work was supported by the Rufford Small Grants Foundation.

REFERENCES

Appel, A. & A.P. Khatiwada (2014): Yellow-throated Martens *Martes flavigula* in the Kanchenjunga Conservation Area, Nepal. *Small Carnivore Conservation 50*: 14–19.

Chutipong, W., J.W. Duckworth, R.J. Timmins, A. Choudhury, A.V. Abramov, S. Roberton, B. Long, H. Rahman, A. Hearn, V. Dinets & D.H.A. Willcox (2016): *Martes flavigula*. The IUCN Red List of Threatened Species 2016. <www.iucnredlist.org/details/41649/0>. Downloaded on May 03, 2018.

Corbett, G.B. & J.E. Hill (1992): The Mammals of the Indomalayan Region: a Systematic Review. Natural History Museum Publications and Oxford University Press, Oxford, UK. Pp. 488.

Datta, A., R. Naniwadekar & A.M. Osuri (2008): Occurrence and conservation status of small carnivores in two protected areas in Arunachal Pradesh. *Small Carnivore Conservation 39*: 1–10.

Duckworth, J.W. (1997): Small carnivores in Laos: a status review with notes on ecology, behaviour and conservation. *Small Carnivore Conservation 16*: 1–21.

Grassman, L., M. Tewes & N. Silvy (2005): Ranging, habitat use and activity patterns of Binturong *Arctictis binturong* and Yellow-throated Marten *Martes flavigula* in north-central Thailand. *Wildlife Biol. 11*: 49–57.

Harrison, D.J., A.K. Fuller & G. Proulx (2004): Martens and fisher (*Martes*) in human-altered environments: an international perspective. Kluwer Academic Publishers, Norwell. 279 pp.

Hon, J., A.J. Hearn, J. Ross, H. Samejima, D.M. Augeri, J. Mathai, A. Mohamed, R. Boonratana, G. Fredriksson, S.M. Cheyne, M. Heydon, Rustam, R. Alfred, G. Semiadi, H. Bernard, D.W. Macdonald, J.L. Belant, S. Kramer-Schadt & A. Wilting (2016): Predicted distribution of the Yellow-throated Marten *Martes flavigula* (Mammalia: Carnivora: Mustelidae) on Borneo. *Raffles Bull. Zool. 33*: 42–49.

IUCN Bangladesh (2015): *Martes flavigula*. IUCN Bangladesh, 2015. IUCN Red List of Threatened Species Version 3.1. <www.iucnredlistbd.org/Species/Single/MA0075>.

Mallick, J.K. (2013): Himalayan Yellow-throated Marten (*Martes flavigula*) in West Bengal, India. *Taprobanica 05*: 89–93.

Nekaris, K.A.I., G.V. Blackham & V. Nijman (2008): Conservation implications of low encounter rates of five nocturnal primate species (*Nycticebus* spp.). *Biodivers. Conserv. 17*: 733–747.

Sathyakumar, S., T. Bashir, T. Bhattacharya & K. Poudyal (2011): Assessing mammal distribution and abundance in intricate eastern Himalayan habitats of Khangchendzonga, Sikkim, India. *Mammalia 75*: 257–268.

Zaw, T., S. Htun, S.H.T. Po, M. Maung, A.J. Lynam, K.T. Latt & J.W. Duckworth (2008): Status and distribution of small carnivores in Myanmar. *Small Carnivore Conservation 38*: 2–28.

Recommended Citation

Hasan, Sabit, Marjan Maria, Shimul Nath and Hassan Al-Razi (2019): Sighting of a Yellow-throated Marten *Martes flavigula* in human dominated landscape of northeastern Bangladesh. *J. Bombay Nat. Hist. Soc. 116*: 86–88. doi: 10.17087/jbnhs/2019/v116/140983

5. GREATER LONG-NOSED FRUIT BAT *MACROGLOSSUS SOBRINUS*: A NEW DISTRIBUTION RECORD IN BANGLADESH[1]

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[1]Accepted June 07, 2019
First published: October 31, 2019 | doi: 10.17087/jbnhs/2019/v116/107425
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Greater Long-nosed Fruit Bat *Macroglossus sobrinus* (K. Anderson, 1911) is a widely distributed species in Southeast Asia, marginally occurring in South Asia. It is categorized by IUCN as Least Concern due to its presence in protected areas and tolerance to habitat alteration (Hutson *et al.* 2008). In South Asia it has a narrow distribution, being known only from the northeastern part of India, from Arunachal Pradesh, Meghalaya, and Mizoram (Molur *et al.* 2002). In northern Myanmar, this bat is reported to be common and large populations are reported from Taho and Biapo (Bates and Harrison 1997).

Bangladesh is positioned in the transitional zone between India and Myanmar, and harbours a number of bat species (Khan 2015). Although, it is a small country with an area of 147,570 sq. km, it has about 23% of the bat species of South Asia (Srinivasulu *et al.* 2010). Unfortunately, very little attention was given to bat research in Bangladesh, and the total number of species remains dynamic among different checklists (Khan 2001; Khan 2008; Sarker and Sarker 2005; Srinivasulu and Srinivasulu 2005). In 2015, IUCN Bangladesh compiled the existing information on bats, and listed 35 species from Bangladesh, including four fruit bats *Pteropus giganteus*, *Cynopterus sphinx*, *Rousettus leschenaultia,* and *Eonycteris spelaea*.

During a field survey in Bhairab Upazila (24° 5′ 9.87″ N; 91° 0′ 58″ E), Kishorgong district, Dhaka division, two adult male fruit bats were entangled in a mist net on October 15, 2016, at 19:30 hrs. It was a rural area with typical homestead vegetation and the mist net was erected at a time when inflorescences were present on banana plants adjacent to the main road. One of the two captured individuals was preserved in alcohol as a voucher specimen (WLMA 0012) in the Wildlife Laboratory of the Department of Zoology, Jahangirnagar University, Bangladesh.

Careful observation of the specimen revealed that it had a characteristically projected and slender muzzle without any median groove on the upper lip, which characterizes *Macroglossus sobrinus* according to Bates and Harrison (1997) and Francis (2008). Besides, the fifth metacarpal (5mt) was equal in length to third metacarpal (3mt) and the wing membrane was attached with the first phalanx of fourth metacarpal (1ph4mt) (Bates and Harrison 1997). The pelage was soft, clay brown on dorsal surface and buffy brown ventrally (Fig. 1).

The following external measurements of the two individuals were recorded: Head body (HB) length: 74.10–78.87 mm; forearm (FA): 46.88–47.01 mm; third metacarpal (3mt): 36.98–37.21 mm; first phalanx of third metacarpal (1ph3mt): 26.53–26.59 mm; second phalanx of third metacarpal (2ph3mt): 29.88–30.98 mm; fourth metacarpal (4mt): 35.15–35.88 mm; first phalanx of fourth metacarpal (1ph4mt) 19.72–20.18 mm; second phalanx of fourth metacarpal (2ph4mt): 20.37–20.97 mm; fifth metacarpal (5mt): 36.58–37.57 mm; first phalanx of fifth

Fig. 1: Greater Long-nosed Fruit Bat *Macroglossus sobrinus* (K. Anderson, 1911), in Bhairab Upazila, Bangladesh. Note the slender muzzle without groove on the upper lip

metacarpal (1ph5mt): 16.88–16.89 mm; second phalanx of fifth metacarpal (2ph5mt): 17.99–19.78 mm; tibia length (TIB) 18.90–19.80 mm; hind feet (HF): 12.76–14.16 mm; ear length (EL): 15.51–17.66 mm, and wing span (WSP): 350–360 mm. On the basis of the external characters and measurements, it was identified as Greater Long-nosed Fruit Bat *Macroglossus sobrinus* (Bates and Harrison 1997; Francis 2008). This species can be distinguished from the smaller Dagger-toothed Long-nosed Fruit Bat *M. minimus*, which has a distinct median groove on the upper lip (Francis 2008).

There was no previous confirmed record of *Macroglossus sobrinus* from Bangladesh (IUCN Bangladesh 2015; Khan 2001, 2015; Khan 2008; Sarker and Sarker 2005). Srinivasulu and Srinivasulu (2005) stated that *M. sobrinus* is likely to be found in Dinajpur, Rangpur, and Mymensingh districts, Bangladesh. This report, substantiated with voucher specimens, confirms the presence of Greater Long-nosed Fruit Bat *Macroglossus sobrinus* (Anderson, 1911), in Bangladesh. As this species is common in both the northeastern part of India and northern Myanmar, it is highly likely to be present in other areas of Bangladesh also. Further studies are required on its ecological aspects in Bangladesh.

REFERENCES

Bates, P.J.J. & D.L. Harrison (1997): Bats of the Indian Subcontinent. Harrison Zoological Museum, Kent, England. 258 pp.

Francis, C.M. (2008): A Field Guide to the Mammals of South-East Asia. New Holland Publishers Ltd, London, UK. 392 pp.

Hutson, A.M., A. Suyano, T. Kingston, P. Bates, C. Francis, S. Molur & C. Srinivasulu (2008): *Macroglossus sobrinus*. The IUCN Red List of Threatened Species 2008: e.T12595A3363666.http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T12595A3363666.en

IUCN Bangladesh (2015): Red List of Bangladesh, Vol. 2: Mammals. International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh. 232 pp.

Khan, M.A.R. (2001): Status and distribution of bats in Bangladesh with notes on their ecology. *Zoos' Print Journal 16(5)*: 479–483.

Khan, M.A.R. (2015): Wildlife of Bangladesh, Checklist and Guide. Chyabithi Publication, Dhaka, Bangladesh. 568 pp.

Khan, M.M.H. (2008): Protected Areas of Bangladesh – A Guide to Wildlife. Nishorgo Program, Bangladesh Forest Department, Dhaka, Bangladesh. 304 pp.

Khan, M.M.H. (2015): Chittagong Hill Tracts – The Land of Diversity. Bangladesh Forest Department, Dhaka, Bangladesh. 167 pp.

Molur, S., G. Marimuthu, C. Srinivasulu, S. Mistry, A.M. Hutson, P.J.J. Bates, S. Walker, K.P. Priya & A.R.B. Priya (Eds) (2002): Status of South Asian Chiroptera: Conservation Assessment and Management Plan (C.A.M.P.) Workshop Report. Zoo Outreach Organisation, Conservation Breeding Specialist Group South Asia, and Wildlife Information & Liaison Development Society, Coimbatore, India, viii+154 pp. + CD.

Sarker, S.U. & N.J. Sarker (2005): Bats of Bangladesh with notes on their status, distribution, and habitat. *BatNet CCINSA Newsletter 6(1)*: 19–20.

Srinivasulu, C. & B. Srinivasulu (2005): A review of chiropteran diversity of Bangladesh. *BatNet CCINSA Newsletter 6(2)*: 6–11.

Srinivasulu, C., P.A. Racey & S. Mistry (2010): A key to the bats (Mammalia: Chiroptera) of South Asia. *Journal of Threatened Taxa 2(7)*: 1001–1076.

Recommended Citation

Mia, Murad, Anik Saha, Mohammed Mostafa Feeroz and Md. Kamrul Hasan (2019): Greater Long-nosed Fruit Bat *Macroglossus sobrinus*: a new distribution record in Bangladesh *J. Bombay Nat. Hist. Soc. 116*: 88–89. doi: 10.17087/jbnhs/2019/v116/107425

6. NEW DISTRIBUTION RECORD OF BLYTH'S HORSESHOE BAT *RHINOLOPHUS LEPIDUS* BLYTH, 1844 (CHIROPTERA: RHINOLOPHIDAE) FROM EASTERN VIDARBHA, MAHARASHTRA, INDIA[1]

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[1]Accepted October 22, 2018
First published: February 28, 2019 | doi: 10.17087/jbnhs/2019/v116/127986
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Introduction

Blyth's Horseshoe Bat *Rhinolophus lepidus*, a member of family Rhinolophidae, is widespread in Southeast Asia and South Asia and distributed widely across the Indian subcontinent. This species can be found in both dry and moist forest and fringe areas (Bates and Harrison 1997). In Malaysia and Thailand, it appears to be associated with intact lowland tropical moist forest. It roosts in caves, tunnels, old and ruined buildings, and old temples (Bunrungsri *et al.* 2008). Its flight is slow and low and it feeds on lepidopterans, coleopterans, dipterans, and hymenopterans (Bates and Harrison 1997). It is distributed in 20 states in India. It has been reported from Rajasthan (Prakash 1963; Senacha 2003; Sinha 1979), Madhya Pradesh (Brosset, 1962; Khajuria 1980; Wroughton 1913), Southern Gujarat (Chakraborty and Agrawal 2000). In Maharashtra state, Helwak (Wroughton 1916); Kanheri caves, Nashik Road (Brosset 1962); Pune (Talmale 2007); Khandala, Lonavala, Lohagad fort, Karnala, Ratnagiri, Panchgani, Mahabaleshwar (Brosset 1962); Khopoli (Tiwari *et al.* 1971); Mulshi, Junnar, Bhimashankar, Mahabaleshwar (Korad 2005; Korad *et al.* 2010).

Decreasing forest cover and increasing tourism in caves may be threats to this species (Molur *et al.* 2002) which is at present in the Least Concern category of IUCN. Here, we present the first record of this species from eastern Maharashtra.

Material and Methods

Study area: Pratapgarh Fort Cave (20° 47′ 43″ N; 80° 6′ 50″ E; Fig. 1) is situated near Pratapgarh village in Arjuni/Morgaon taluka in Gondia district of Maharashtra state. This site lies in Nagpur division of Vidarbha region, 87 km south of the district headquarters at Gondia. It is famous for a Lord Shiva temple, which draws visitors in large numbers on the occasion of Maha Shivaratri.

Fig. 1: Cave mouth at Pratapgarh Fort

Methodology: In April 2012, an opportunistic survey was undertaken at the cave site to assess the diversity of bats. A dead bat specimen (n=1) was found near the mouth of the cave. It was photographed and carefully preserved in 4% formalin. The specimen was forwarded to Zoological Survey of India (ZSI), Central Zone Regional Centre, Jabalpur, Madhya Pradesh, India for further study and identification. A skull of a specimen of the same bat was prepared for study according to Agrawal (1990).

Results and Discussion

Three bats were observed in a cave in Pratapgarh Fort, roosting on the ceiling. Before we could recognize and identify them, they sensed our presence and took flight. Our interest was focused on one specimen (n=1) found freshly dead inside the cave. The animal was handled carefully and preserved in 4% formalin for further study. The specimen is recorded in ZSI as ZSI/CZRC/V-6348. As per the identification report of ZSI, CRC, Jabalpur, the details are as under.

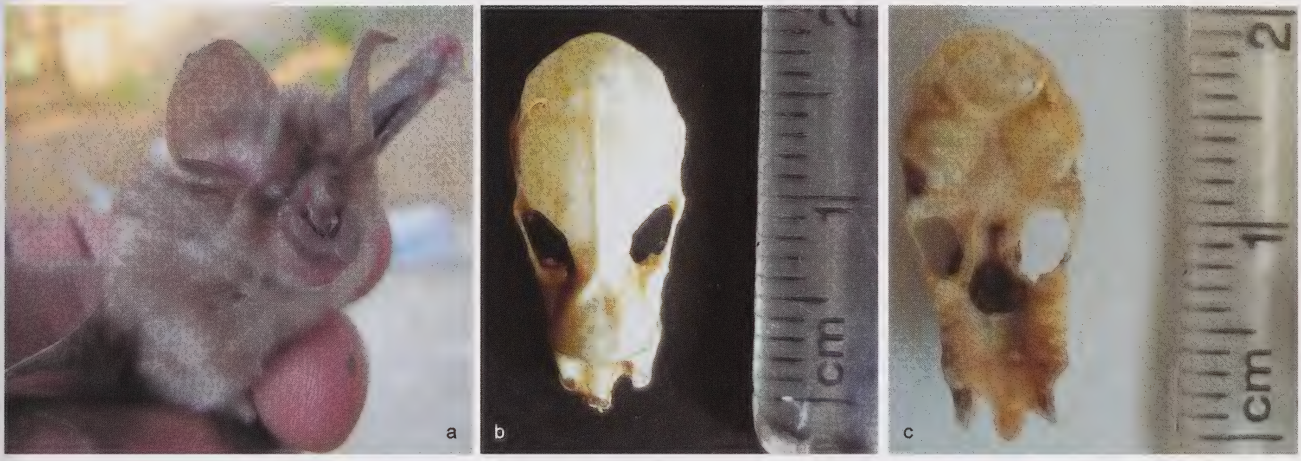

Fig. 2: *Rhinolophus lepidus* a) frontal view, b) Skull: ventral view, c) Skull: dorsal view

Phylum : Chordata
Class : Mammalia
Order : Chiroptera
Family : Rhinolophidae
Genus & Species : *Rhinolophus lepidus* Blyth, 1844

The specimen was identified as female. Measurements were taken as per Bates and Harrison (1997).

External characters: Small sized horseshoe bat (Fig. 2a). Ears medium sized, 14.2 mm in height, TL 20.3 mm. Wings: third metacarpal length (3 mt) 33.1 mm, fourth (4 mt) 43.2 mm, and fifth (5 mt) 32.9 mm. Hind foot length (HF): 7.3 mm. Forearm length (FA): 42.1 mm; Tibia length (TIB): 15.3 mm.

Cranio-dental characters: Skull small, but strongly built. Greatest length of skull (GTL) 17.8 mm (Fig. 2 b and c); condylo-canine length (CCL) 15.0 mm; greatest zygomatic width (ZB): 7.9 mm; Breadth of brain case (BB) 7.2 mm; Maxillary tooth row (CM^3) 6.3 mm; Mandibular tooth row (CM_3) 7.4 mm; Anterior palatal width (C^1-C^1) 4.2 mm: Posterior palatal width (M^3-M^3) 5.9 mm; Mandibular length (ML) 11.1 mm.

Current Status: The present record represents the first record of *R. lepidus* from eastern Maharashtra (Vidarbha region). This species is widespread in South Asia and Southeast Asia. In South Asia, it has been recorded up to an elevation of 2,330 m above sea level and is known from Afghanistan, Bangladesh, Nepal, Bhutan, Pakistan, and India (Andhra Pradesh, Assam, Bihar, Delhi, Karnataka, Kerala, Gujarat, Himachal Pradesh, Madhya Pradesh, Maharashtra, Meghalaya, Mizoram, Nagaland, Orissa (now Odisha), Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh, and West Bengal (Molur *et al.* 2002). In Maharashtra state, Helwak (Wroughton 1916); Kanheri caves, Nashik Road (Brosset 1962); Pune (Talmale 2007); Khandala, Lonavala, Lohagad fort, Karnala, Ratnagiri, Panchgani, Mahabaleshwar (Brosset 1962; Korad *et al.* 2006); Khopoli (Tiwari *et al.* 1972); Mulshi, Junnar, Bhimashankar, Mahabaleshwar (Korad 2005; Korad *et al.* 2010).

The occurrence of this species in eastern Maharashtra would be expected because it has also been recorded from neighbouring regions in Madhya Pradesh. Horseshoe bats *Rhinolophus* spp. are known to roost selectively where both macro and micro habitats play an important role in roost selection (Ponmalar and Vanitharani 2014). The cave at Pratapgarh Fort is located on the far side of the hilltop, moderately protected from anthropogenic activities, which enhances the possibility of habitation by bats.

Conflict of interest: The authors declare that there is no conflict of interest.

ACKNOWLEDGEMENTS

The authors are thankful to the entire team of ZSI, CRC, Jabalpur, Madhya Pradesh, India, for help in examination and identification of the specimen.

REFERENCES

Agrawal, V.C. (1990): Mammalia. *In:* Collection and Preservation of Animals. Published by the Director, Zoological Survey of India, Calcutta. Pp. 215–236.

Bates, P.J.J. & D.L. Harrison (1997): Bats of the Indian Subcontinent.

Harrison Zoological Museum, Kent, England. 258 pp.

Brosset, A. (1962): The bats of Central & Western India. Part II. *J. Bombay Nat. Hist. Soc. 59*: 583–624.

Bumrungsri, S., C. Francis & G. Csorba (2008): *Rhinolophus lepidus*. The IUCN Red List of Threatened Species 2008: e.T19547A8971569.

Chakraborty, S. & V.C. Agrawal (2000): Mammalia. *In*: Fauna of Gujarat (Part-II) State Fauna Series No. 8. Published by the Director, Zoological Survey of India, Kolkata. Pp. 15–83.

Khajuria, H. (1980): Taxonomical and ecological studies on the bats of Jabalpur dist., Madhya Pradesh .. India .. Pte II (Families: Megadermatidae. Rhinolophidae. and Vespertilionidae). *Rec. zool. Surv. India, Occ. Pap. No. 19* : 1–69.

Korad, V.S. (2005): Assessment of Bat fauna in the Central Western Ghats of Maharashtra: (2002–2005). Report submitted to Ministry of Environment and Forests, Govt of India. 72 pp.

Korad, V.S., M.C. Gaikwad & A.L. Koratkar (2006): Records of composite bat colonies in Robber's Cave area of Mahabaleshwar region, Maharashtra State, India. *Ecology, Environment & Conservation 12*: 743–748.

Korad, V.S., R.N. Raut & M.S. Pradhan (2010): Morphometrics of the genus *Hipposideros* from Northern Western Ghats of Maharashtra. *Biosystematica 4*: 31–38.

Molur, S., G. Marimuthu, C. Srinivasulu, S. Mistry, A.M. Hutson, P.J.J. Bates, S. Walker, K. Padmapriya & A.R. Binupriya (2002): Status of South Asian Chiroptera: Conservation Assessment and Management Plan (C.A.M.P). workshop report, 2002. Zoo Outreach Organisation, CBSG South Asia and WILD, Coimbatore, India, CD-Rom.

Ponmalar, S. & J. Vanitharani (2014): Insect pest management by the horse shoe bats (*Rhinolophus* sp.) in the forest ecosystem of Kalakad Mundanthurai Tiger Reserve, India. Scrut. Internal Res. *J. Biol. Environ. Sci. 1:5*. 1–19.

Prakash, I. (1963): Taxonomic and biological observations on the bats of the Rajasthan desert. *Records of the Indian Museum 59 (1961)*: 149–170.

Senacha, K.R. (2003). Eco-status and demographic changes among chiropterans of the Thar Desert with special reference to Jodhpur. Ph.D. Thesis, J.N.V. University, Jodhpur, India. Pp. 77–84.

Sinha, Y.P. (1979): Studies on Taxonomy, Distribution, Zoogeography, Osteology & Field Ecology of Bats of Rajasthan, specially the Indian Desert. Ph.D. Dissertation, Jodhpur University. 201 pp.

Talmale, S.S. (2007): Small Mammal Diversity in Maharashtra State. Ph.D. Thesis, University of Pune.

Tiwari, K.K., R.K. Ghose & S. Chakraborty (1971): Notes on a collection of small mammals from Western Ghats with remarks on the status of *Rattus rufescens* (Gray) and *Bandicota indica malabarica* (Shaw). *J. Bombay Nat. Hist. Soc. 68(2)*: 378–384.

Wroughton, R.C. (1913): Report No. 7 (with K.V. Ryley): Central Provinces. Bombay Natural History Society's Mammal Survey of India. *J. Bombay Nat. Hist. Soc. 22(1)*: 45–58.

Wroughton, R.C. (1916): (i) Report no. 20: Chindwin River (309–310); (ii) Report No. 21: Gwalior (309–310); (iii) Report No. 22: Koyna Valley (311–316). Bombay Natural History Society's Mammal Survey of India. *J. Bombay Nat. Hist. Soc. 24(2)*: 291–316.

Recommended Citation

Paliwal, Gopal, Sudhir Bhandarkar, Shyamkant Talmale, Ankur Kali and Milind Umare (2019): New distribution record of Blyth's Horseshoe Bat *Rhinolophus lepidus* Blyth, 1844 (Chiroptera: Rhinolophidae) from Eastern Vidarbha, Maharashtra, India. *J. Bombay Nat. Hist. Soc. 116*: 90–92. doi: 10.17087/jbnhs/2019/v116/127986

7. FIRST RECORD OF OCCURRENCE OF PACIFIC RAT *RATTUS EXULANS* (PEALE, 1848) FROM BANGLADESH[1]

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[1]Accepted March 27, 2019
First published: June 28, 2019 | doi: 10.17087/jbnhs/2019/v116/103155
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Pacific Rat *Rattus exulans* is the smallest species of genus *Rattus* found in Myanmar, Thailand, Laos, Vietnam, Cambodia, Malaysia, Singapore, Indonesia, and New Zealand (Francis 2008). This species occurs in a wide variety of habitats, such as tropical and subtropical dry deciduous forests, tropical and subtropical mangrove forests, coastal hill forests, low lands, agricultural lands, and also human settlements (Ruedas *et al.* 2016).

The Chittagong Hill Tracts (CHT) is a unique, rugged, and hilly terrain located in the southeastern part of Bangladesh. It is covered with stunted forest and large tracts of bamboo. Mass eruption of rodents has been observed during bamboo flowering in CHT (Chakma 2015). However, very scanty information is available on the rodents of CHT. Therefore, we undertook this study to investigate species diversity and habitat preference of rodents in CHT. The surveys were

Table 1: Morphometric measurements of *Rattus exulans* and *Rattus rattus* (from Francis, 2008)

Morphometry (mm)	Studied specimen	*Rattus exulans*	*Rattus rattus*
Head and body length	115	90–140	105–215
Tail length	118	105–160	120–230
Hindfoot length	25	21–26	26–40
Ear length	17.5	15–18	17–25
Condylobasal length	23	27–30	33–43
Weight (gm)	47.3	25–60	100–200

Fig. 1: Pacific Rat *Rattus exulans* in Bangladesh

carried out at Alikadam, Ruma, and Rajasthali subdistricts, from November 2015 to October 2016.

We used live cage traps (12″ x 6″ x 5″) to capture the rodents. Traps were baited with dry fish and placed in different habitats including community households, bamboo forests, cultivated areas, gardens, and woodlands. A total of 12 cage traps were deployed for 27 consecutive nights, i.e., 324 trap night efforts. We captured 127 rats, and among them a peculiar rat was captured in a community household (21° 53′ N; 92° 17′ E) in Ruma bazaar area of Ruma subdistrict, Bandarban, on March 15, 2016. This rat was trapped from the piles of maize *Zea mays* stored in the house. Morphometric measurements of the trapped rat were taken using Vernier calipers (Table 1). It was an adult male (testes descended in scrotal sac), with reddish brown above and pale greyish underparts (Fig. 1). Tail was completely dark. On the basis of morphometric data (Table 1), it was identified as Pacific Rat *Rattus exulans* (Francis 2008). Though *R. exulans* closely resembles *Rattus rattus*, it has comparatively smaller body size and footpads. In addition, *R. exulans* has a slightly dark edge on the upper side of the hindfoot near the ankle, unlike the closely related *R. tanezumi* (Francis 2008).

Rodent studies in Bangladesh are still in their infancy and most of the data available is either old or secondary. Some studies mentioned the presence of *Rattus exulans* in Bangladesh (Khan 2015; Ruedas *et al.* 2016), while another highlighted its absence (Ahmed 2009). However, none of these authors have directly seen or trapped *R. exulans* in Bangladesh; they speculated on its presence, based on the occurrence of the species in nearby countries. However, we confirm the presence of Pacific Rat *R. exulans* for the first time in Bangladesh by trapping the species. More specimen samples along with molecular investigations would strengthen the record of the presence of this species in Bangladesh.

REFERENCES

Ahmed, Z.U. (2009): Mammals, Encyclopedia of Flora and Fauna of Bangladesh. Vol. 27. Asiatic Society of Bangladesh, Dhaka.

Chakma, N. (2015): Rodent population outbreaks in relation to bamboo flowering in the Chittagong hill tracts, its impacts on crop production and environment. Department of Zoology, University of Dhaka. Pp. 20–23.

Francis, C.M. (2008): A Field Guide to the Mammals of South-East Asia. New Holland Publishers Ltd, London, U.K. 353 pp.

Khan, M.A.R. (2015): Wildlife of Bangladesh: checklist and guide. Chyabithi, Dhaka, Bangladesh. 568 pp.

Ruedas, L., L. Heaney & S. Molur (2016): *Rattus exulans* (errata version published in 2017). The IUCN Red List of Threatened Species 2016: e.T19330A115146549. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T19330A22440938.en. Downloaded on January 21,2019.

Recommended Citation

Rahman, Tawfiqur, Mohammed Mostafa Feeroz and Md Kamrul Hasan (2019): First record of occurrence of Pacific Rat *Rattus exulans* (Peale, 1848) from Bangladesh. *J. Bombay Nat. Hist. Soc. 116*: 92–93. doi: 10.17087/jbnhs/2019/v116/103155

8. EVIDENCE OF LATE SURVIVAL OF SCHOMBURGK'S DEER *RUCERVUS SCHOMBURGKI* IN CENTRAL LAOS[1]

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[1]Accepted April 02, 2019
First published: August 31, 2019 | doi: 10.17087/jbnhs/2019/v116/142873
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Schomburgk's Deer *Rucervus schomburgki* (Blyth, 1863), a poorly known cervid with wide-spreading antlers, is supposedly extinct since 1938. This deer was a grazer, found in grassy lowland areas of Thailand's Chao Phraya river drainage (Giles 1937). J. Campbell (quoted in Brooke, 1876) suggested that some antler specimens may even have originated in "Laos or Shan", and there were certainly areas in the Mekong river drainage, in Laos for example, that would have constituted appropriate habitat.

In February 1991, L. Chazée photographed a set of Schomburgk's Deer antlers at a shop in the northern Laos province of Phongsali (Schroering 1995). Provenance was unknown, but much later it proved possible for one of us (GBS) to interview the person who had obtained the antlers and brought them to Phongsali. That individual, a trucker, stated that he had acquired the antlers at Khamkeut (18° 10′ 45″ N; 104° 56′ 39″ E), in Bolikhamxai Province of central Laos, and that they had been in fresh condition.

Fig. 1: Antlers of *Rucervus schomburgki* in 1991 (courtesy of Laurent Chazée)

Fig. 2: Enlarged view of pedicles of the antlers in Fig. 1

Fortunately, the freshness of the antlers can be independently assessed via their photographically documented physical condition (Figs 1 and 2). The antlers had been anthropogenically excised from the skull at their bases. Tannin stains on the tines resulting from soil-jabbing are evident [see Schaller (1967), for a description of this behaviour in the related Barasingha Deer *Rucervus duvaucelii*], and areas of dried periosteum still adhered to the lateral surfaces of the two pedicles. In a transverse sectional view (where excision had occurred) of one pedicle, trabecular bone may be readily distinguished from the shell of cortical bone encasing it (Fig. 2). A substantial portion of the trabecular surface displays the dark red to reddish brown colour of dried blood, apparently masked in places by paler marrow-derived exudate. The condition of the antlers is thus consistent with the claim of their fresh condition. This appearance may be

Fig. 3: Comparative transverse section view of an old cervid specimen (GBS)

compared with that of an old cervid collection specimen in Thailand (Fig. 3).

On the basis of this evidence, we suggest that Schomburgk's deer was still extant at the beginning of the 1990s, presumably as a relict population somewhere in central Laos, well to the east of the documented area of distribution in Thailand. It may be relevant that antlers of this supposedly extinct deer were reported for sale via other markets (Martin and Phipps 1992; Srikosamatara *et al.* 1992) at about the same time; perhaps a small population was being newly harvested by hunters. It is conceivable, albeit unlikely, that the species might still exist in Laos today, an important consideration for conservation biologists.

ACKNOWLEDGEMENTS

The authors thank the following colleagues for assistance: Diethard Ande, James R. Chamberlain, Laurent Chazée, J. William Duckworth, George B. Schaller, Sompoad Srikosamatara, Anne Wright, and Belinda Wright. GJG acknowledges support from Weinberg College of Northwestern University.

REFERENCES

Brooke, V. (1876): On *Cervus schomburgki* (Blyth). *Proc. Zool. Soc. (Lond.) 1876:* 304–307.
Giles, F.H. (1937): The riddle of *Cervus schomburgki*. *J. Siam Soc. Nat. Hist. Suppl. 11 (1)*: 1–34 + 4 pls.
Martin, B. & M. Phipps (1992): A review of wild animal trade in Cambodia. *Traffic Bull. 16(2)*: 45–51.
Schaller, G.B. (1967): The Deer and the Tiger. University of Chicago Press. 370 pp.
Schroering, G.B. (1995): Swamp deer resurfaces. *Wildlife Conservation 98(6)*: 22.
Srikosamatara, S., B. Siripholdej & V. Suteethorn (1992): Wildlife trade in Lao P.D.R. and between Lao P.D.R. and Thailand. *Nat. Hist. Bull. Siam Soc. 40*: 1–47.

Recommended Citation

Schroering, G.B. and Gary J. Galbreath (2019): Evidence of late survival of Schomburgk's Deer *Rucervus schomburgki* in central Laos. *J. Bombay Nat. Hist. Soc. 116*: 94–95. doi: 10.17087/jbnhs/2019/v116/142873

9. SIGHTING OF EURASIAN BITTERN *BOTAURUS STELLARIS* IN TALZAN TEKDY (CHARKOP – KANDIVALI, MUMBAI), MAHARASHTRA, INDIA[1]

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[1]Accepted May 29, 2019
First published: December 31, 2019 | doi: 10.17087/jbnhs/2019/v116/142461
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The Eurasian Bittern *Botaurus stellaris* is a migratory wader of the heron family. It is a large brownish bird having stout, long neck with dark brown mottling, streaking, and cross-barring on golden-buff plumage. It is usually found hidden in thick vegetation across wetlands in temperate and tropical regions. It usually remains hidden in reed beds and is most often seen flying low over the reed tops. It hunts alone, walking stealthily through vegetation, often with intervals of standing motionless (Grimmett *et al.* 2014). It prefers waterbodies since it feeds on fish, crabs, frogs, and even small reptiles. These birds flock from Europe and central Asia during the winter and are also called the great bittern.

In India, they are winter migrants throughout the region; however, they are considered rare in the south (Rasmussen 2005).

On January 01, 2019, around 08:45 hrs, while birding near the lakes of Talzan Tekdy at Charkop, Kandivali, near Gorai Creek (Maharashtra), a solitary bird hidden behind the reeds inside the lake was spotted. It was identified as Eurasian Bittern after consulting literature (Grimmett *et al.* 2014). The bird was preening and basking at the same place; it stayed there for more than an hour. The bird was observed over the next few months. Its behaviour was not shy on most of the occasions, and it remained at the same few places during the months of observation.

All the recent records of Eurasian Bittern in India are from places other than Mumbai region. Hence, the sighting of Eurasian Bittern in Talzan Tekdy (Charkop, Kandivali), Mumbai, is important. We believe this to be the first sighting and documentation of a Eurasian Bittern in Mumbai area after

80 years. This sighting was first e-published at https://ebird.org/india/subnational2/IN-MH-MS?yr=all&m=&rank=lrec on January 01, 2019 (eBird 2019). Prior to this, the bird was last sighted in Mumbai in 1939 (Ali and Abdulali 1939). However, it did make a brief visit to Vasai outskirts in November 2017 (eBird 2017). The nearest earlier sighting of it was on January 14, 2014, at Amravati, Maharashtra (Gupta 2015).

The area mentioned is under threat from unplanned rapid urbanization.

ACKNOWLEDGEMENTS

I thank the entire birding community, organizations involved in nature conservation, including BNHS, ENVIS and my family for their constant support.

REFERENCES

Ali, S. & H. Abdulali (1939): The birds of Bombay and Salsette. Part VI. *J. Bombay Nat. Hist. Soc. 40(4)*: 628–652.

Ebird (2017): Vasai Outskirts. https://ebird.org/checklist/S40739839. Accessed on December 06, 2019.

Ebird (2019): Mumbai Suburban. https://ebird.org/india/subnational2/IN-MH-MS?yr=all&m=&rank=lrec. Accessed on December 06, 2019.

Grimmett, R., C. Inskipp & T. Inskipp (2014): Birds of the Indian Subcontinent. 2nd edn. Oxford University Press. 80 pp.

Gupta, Rahul (2015): Sighting of the Eurasian Bittern *Botaurus stellaris* at Amravati, Maharashtra, India. *IndianBIRDS 10(1)*: 24. http://indianbirds.in/pdfs/IB_10_1_Gupta_EurasianBittern.pdf

Rasmussen, P.C. & J. C. Anderton (2005): Birds of South Asia. The Ripley Guide. Vols 1 and 2. Smithsonian Institution and Lynx Edicions, Washington, D.C. and Barcelona.

Recommended Citation

Munsiff, Kunal (2019): Sighting of Eurasian Bittern *Botaurus stellaris* in Talzan Tekdy (Charkop – Kandivali, Mumbai), Maharashtra, India. *J. Bombay Nat. Hist. Soc. 116*: 95–96. doi: 10.17087/jbnhs/2019/v116/142461

10. BACKCROSS GADWALL *MARECA STREPERA* X FALCATED DUCK *MARECA FALCATA* WITH GADWALL NEAR RAJKOT, GUJARAT, INDIA[1]

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[1]Accepted March 08, 2019
First published: September 30, 2019 | doi: 10.17087/jbnhs/2019/v116/140859
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Introduction

Natural interbreeding or hybridization plays an important role in evolution, such as adaptive trait transfer, adaptive radiation, and the origin of species. However, hybridization can have subsequent ill effects as well (Ottenburghs *et al.* 2015). In the animal kingdom, hybridization is a common phenomenon at the species level and is relatively high in birds (Ottenburghs *et al.* 2015). The subject of this note is a backcross hybrid gadwall we observed near Rajkot, Gujarat.

Gadwall *Mareca strepera* breeds in Europe and Central Asia and in the Old World. It is a common winter visitor to India and Gujarat, lessening towards the southern parts of the Indian subcontinent, and becoming rare in south India (Ali and Ripley 1973).

Falcated Duck *Mareca falcata* breeds in northern Asia, south of the Arctic Circle from the upper Yenisey to Kamchatka, south to Lake Baikal, north Mongolia, and the Amur and Ussuriland. It is a rare but regular winter visitor to northern India (Dharmakumarsinhji 1955), seen in Assam and

Fig. 1: Hybrid Gadwall, Rajkot, Gujarat

Manipur with vagrant records from inland (Ali and Ripley 1973). It is vagrant in Gujarat (Ganpule 2016), with historical records from Kachchh (Ali and Ripley 1973; Vijayrajji 1932) and Jamnagar (Natarajan and Akhtar 1987).

Hybridization in waterfowls:

Hybridization occurs in nature in three ways (Hybrid Duck Study 2018): i) Forced Copulation: Waterfowl are known for forced copulation, referred to as rape. Mallard, pintail, gadwall, and green-winged teals mostly engage in forced copulation; ii) Brood-parasitism: Hybrid waterfowl can be the result of interspecific brood parasitism, which occurs when one species lays eggs in the nest of another species. Parasitic young become at least partly sexually imprinted on their host species, giving them some propensity to mate with that species; iii) Shortage of mates: In the case of a female forming a pair bond outside of her normal distributional range, a scarcity of conspecific males can be a cause of hybridization. If a species is common in a range but another is rare, there is a greater chance that the rare species may not find a conspecific mate, and hybridization may occur.

Captive and natural hybridization of falcated duck and gadwall has been reported (McCarthy 2006), as their breeding range overlaps in southern Siberia, according to McCarthy (2006); however, the two species also share a common breeding ground across Eastern Asia (Dhami *et al.* 2018). Falcated Duck and Gadwall crossbreeding has been recorded from Assam (McCarthy 2006). However, there are no records from Gujarat.

On November 01, 2018, while birding at a lake on the outskirts of Rajkot, Gujarat, we saw an odd looking gadwall, with head and body coloration different from normal gadwalls. Indeed it was a hybrid, but we could not identify the parentage of the cross. We returned to the same place to photograph the bird on November 03, 2018. At 09:30 hrs, we spotted it and were able to photograph it (Fig. 1). On both days it was feeding and basking with a flock of other gadwalls, making loud single "quack" calls occasionally (heard twice).

We sent the photographs to Sébastien Reeber (author of WATERFOWL OF NORTH AMERICA, EUROPE & ASIA) for identification. It was identified as a hybrid between Gadwall and Falcated Duck from the green sheen behind the eyes, mahogany brown crown and hindneck, wholly black bill, whitish patch on the forehead, all of which pertain to Falcated Duck. Later on, it was precisely identified as a backcross (i.e., offspring of Gadwall and Falcated Duck crossed with Gadwall), due to the bird being much closer to Gadwall than the usual hybrids from this cross.

The only other possible species would have been Eurasian Teal, which was eliminated because at least the forehead would have been darker for that cross.

ACKNOWLEDGEMENT

We are thankful to Sébastien Reeber for his help with identification.

REFERENCES

Ali, S. & S.D. Ripley (1973): Handbook of the Birds of India and Pakistan together with those of Bangladesh, Nepal, Sikkim, Bhutan and Sri Lanka. Warblers to Redstarts. Vol. 1. Oxford University Press, Bombay.

Dhami, K.K., Y.N. Zhuravlev & J.L. Peters (2018): Coalescent history of nuclear introgression between gadwall and falcated duck fails to explain among-locus heterogeneity in genetic diversity. *Int. J. Avian & Wildlife Biol. 3(3)*: 186–197. doi: 10.15406/ijawb.2018.03.00084.

Dharmakumarsinhji, R.S. (Undated): Birds of Saurashtra, India with additional notes on the Birds of Kutch and Gujarat. Bhavnagar, Saurashtra. [Published in 1955]

Ganpule, P. (2016): The Birds of Gujarat: Status and Distribution. *Flamingo 8(3)-12(4)*: 2–40.

Hybrid Duck Study (2018): Why do waterfowl hybridize? http://hybridduck.blogspot.com/p/hybrid-origins.html. Accessed on November 27, 2018.

Ottenburghs, Jente, Ronald C. Ydenberg, Pim Van Hooft, Sip van Wieren & Herbert H.T. Prins (2015): The Avian Hybrids Project: gathering the scientific literature on avian hybridization. *Ibis 157(4)*: 892–894.

McCarthy, E. (2006): Handbook of Avian Hybrids of the World. Oxford University Press, New York.

Natarajan, V. & A. Akhtar (1987): Occurrence of the Falcated Teal *Anas falcata* (Georgi) in Khijadia Bird Sanctuary, Gujarat. *J. Bombay Nat. Hist. Soc. 84(3)*: 678.

Vijayraji (1932): Occurrence of the Bronzecapped or Falcated Teal *Eunetta falcata* in Kutch. *J. Bombay Nat. Hist. Soc. 35(4)*: 899.

Recommended Citation

Trivedi, Krunal and Akshay Trivedi (2019): Backcross Gadwall *Mareca strepera* X Falcated Duck *Mareca falcata* with Gadwall near Rajkot, Gujarat, India. *J. Bombay Nat. Hist. Soc. 116*: 96–97. doi: 10.17087/jbnhs/2019/v116/140859

11. THE AMUR FALCON *FALCO AMURENSIS* IN TAL CHHAPAR WILDLIFE SANCTUARY – SECOND RECORD FOR RAJASTHAN, INDIA[1]

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[1]Accepted June 08, 2018
First published: February 28, 2019 | doi: 10.17087/jbnhs/2019/v116/121071
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On August 6, 2017, at *c.* 17:30 hrs, while on a field visit in Tal Chhapar Wildlife Sanctuary (27° 48′ N; 74° 26′ E), Churu district, Rajasthan, the first author (SSP) came across a single falcon sitting on an *Acacia nilotica* tree at a height of *c.* 2–2.5 m from the ground. It was not shy, allowed a close approach and was observed for *c.* 25–30 mins. The bird was dark grey in plumage with orangish colour to its cere, eye-ring, legs, feet, and thighs. The bird was photographed and one of the pictures shows white underwing with strong dark barring and dark trailing edges. The pictures were sent to James Eaton, Pamela Rasmussen, and Brian Small for comments. James Eaton wrote back that it was a young Amur Falcon *Falco amurensis* (*in litt.* email dated August 12, 2017). Pamela Rasmussen confirmed that the images were of a subadult male Amur Falcon (*in litt.* email dated August 16, 2017). Brian Small (*in litt.* email dated August 12, 2017), while commenting on the images, wrote that the bird was 'a second-calendar year male Amur Falcon, showing vestigial streaking on the underparts and face pattern, but mostly the very white underwing coverts marked with black; typical of this species at this age'. SSP saw the same individual at the same location between 06:10 hrs and 06:35 hrs on August 7, 2017 and between 16:30 hrs and 17:00 hrs on August 8, 2017. On both occasions, the bird was actively catching dragonflies in flight, often coming back to perch on the small trees. The bird was seen again on August 12, 2017 in the same area (Sudhir Garg pers. comm.). Thereafter, SSP recorded its presence in the same area on five occasions, the last sighting being on September 13, 2017.

The status of Amur Falcon is listed by IUCN as 'Least Concern', having an extremely large range (BirdLife International 2017). It breeds from central Siberia east to Amurland, south to northern and eastern China, winters in eastern and southern Africa, and is mainly a passage migrant in east and southeast Asia (Naoroji 2007). The species is highly migratory, travelling upto 11,000 km between its breeding grounds and wintering areas, flying at very high altitudes where it is invisible from the ground (Ferguson-Lees and Christie 2001). It is a fall passage migrant through central and east Himalaya, south Assam hills, east Meghalaya, Cachar, Manipur, and peninsular India (Rasmussen and Anderton 2012). In India, it is scarce in areas north of central India and west of north-east India. It is an uncommon autumn passage migrant in Uttarakhand, where MS recorded up to 150–200 birds at Dhikala grassland in Corbett Tiger Reserve on November 15, 1997. It is recorded as a rare visitor at Dharamshala in Himachal Pradesh, where only two birds were seen (den Besten 2004). There is only one record of the species from Rajasthan, where a small party of five birds was observed at Phulwari Wildlife Sanctuary during October 2003 (Sangha *et al.* 2007). Though its autumn passage through India is well-documented, there are some records of the species during spring migration from the country. MS & HSS recorded it from Nagaland during May 2011 and from Arunachal Pradesh during May 2013 (Sharma *et al.* 2014).

In recent years, mass killing of Amur Falcon was reported from the state of Nagaland (Patton and Bhaskar 2014), where an estimated 100,000 birds were poached within a span of two weeks during the autumn of 2012 (Sinha 2014). An intensive awareness initiative by the central and state governments resulted in sharp decline in the mass killing of the species in the area (Sinha 2015). In 2013, three Amur Falcons were satellite-tagged in Nagaland to map the species' migration route (Kasambe 2014). Prior to this, its spring migration route was considered mysterious, as there are some south-east Asian records and it was believed that the species migrates across the Indian Ocean, south of the Indian subcontinent (Rasmussen and Anderton 2012). During 2014, two of the three satellite-tagged birds were traced flying across India on their return migration (Kumar 2014). The migration of Amur Falcon from the Russian far east to southern Africa is "one of the greatest ornithological mysteries of the present day" (Naoroji 2007) and is still not fully understood. Dragonflies form a major part of the diet of Amur Falcon on their migration and it is worth noting that its migration across the Indian Ocean coincides with the similar migration of some dragonflies (Order Odonata), from the western coast of India to the eastern coast of Africa (Anderson 2009).

In May 2015, it was discovered for the first time that one of the satellite-tracked birds, 'Naga', was flying over Rajasthan, probably at elevations above 1,000 m, travelling above Barmer, Phalodi, Bikaner, and Jhunjhunu districts, on its return migration (Singh 2015; http://morungexpress.com/wp-content/uploads/2015/05/221.jpg). We speculate that it is possible that on its return migration during 2017, the present bird could not continue its migration beyond Rajasthan for some unknown reason and was recorded at Tal Chhapar.

ACKNOWLEDGEMENTS

MS wants to thank Brian Small, James Eaton, and Pamela Rasmussen for their comments about the plumage of the bird. HSS wants to thank Sudhir Garg for sharing his sight record.

REFERENCES

Anderson, R.C. (2009): Do dragonflies migrate across the western Indian Ocean? *Journal of Tropical Ecology 25(4)*: 347–358.

BirdLife International (2017): Species factsheet: *Falco amurensis*. Downloaded on December 17, 2017 from http://www.birdlife.org

den Besten, J.W. (2004): Birds of Kangra. Moonpeak Publishers, Dharamshala & Mosaic Books, New Delhi. 173 pp.

Ferguson-Lees, J. & D.A. Christie (2001): Raptors of the World. Christopher Helm, London. Pp. 867–869.

Kasambe, R.(2014): Doyang Reservoir: A potential IBA in Nagaland. *Mistnet 15(2)*: 24–28.

Kumar, R.S. (2014): Tracking the incredible journey of a small raptor – Amur Falcon from India. *Mistnet 15(2)*: 14–18.

Naoroji, R. (2007): Birds of Prey of the Indian Subcontinent. Om Books International, New Delhi. 692 pp.

Patton, Z. & K.H. Bhaskar (2014): Conservation initiatives by the Nagaland Forest Department for the migratory Amur Falcon. *Mistnet 15(2)*: 4–13.

Rasmussen, P.C. & J.C. Anderton (2012): Birds of South Asia: the Ripley Guide. 2 Vols. Smithsonian Institution, Washington, D.C. Michigan and Lynx Edicions, Barcelona. Pp. 1–378 & 1–683.

Sangha, H.S., D. Devarshi & S.K. Sharma (2007): The Amur Falcon *Falco amurensis* Radde in Phulwari Wildlife Sanctuary – first record for Rajasthan. *J. Bombay Nat Hist. Soc. 103(1)*: 98–99.

Sharma, M., H.S. Sangha & A. Jain (2014): Some noteworthy records from Lohit Valley, eastern Arunachal Pradesh, India. *Indian BIRDS 9(4)*: 88–92.

Singh, R. (2015): Amur falcons' new migration path amazes ornithologists. *The Times of India*. (Online edition updated on May 24, 2015). Downloaded on January 23, 2018 from https://timesofindia.indiatimes.com/home/science/Amur-falcons-new-migration-path-amazes-ornithologists/articleshow/47401294.cms

Sinha, N. (2014): Working together to face a crisis. *Mistnet 15(2)*: 22–23.

Sinha, N. (2015): No mass-hunting of Amur Falcons in Doyang for a second year. *Hornbill* January–March: 38–39.

Recommended Citation

Poonia, Surat Singh, Manoj Sharma and Harkirat Singh Sangha (2019): The Amur Falcon *Falco amurensis* in Tal Chhapar Wildlife Sanctuary – second record for Rajasthan, India. *J. Bombay Nat. Hist. Soc. 116*: 98–99. doi: 10.17087/jbnhs/2019/v116/121071

12. FIRST RECORD OF GREY-HEADED LAPWING *VANELLUS CINEREUS* FROM HIMACHAL PRADESH, INDIA[1]

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[1]Accepted October 19, 2018
First published: May 31, 2019 | doi: 10.17087/jbnhs/2019/v116/131215
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Grey-headed Lapwing *Vanellus cinereus* is a large, pale plover; in the breeding season it has a grey head, neck, and breast, the last with a diffuse black border. It has a red iris, yellow bill with black tip, yellow legs, and a broad black terminal band on the tail (Grimmett *et al.* 1998; Rasmussen and Anderton 2012). It breeds in north-eastern and eastern China and neighbouring parts of Russia and Japan, and winters in South Asia from Nepal, northern and north-east India, and Bangladesh, to south-central China and northern Indochina, occasionally further south (Wiersma and Kirwan 2018).

Sighting: On March 28, 2015, I went to Sthana village, Kangra district, Himachal Pradesh (31° 57′ N; 75° 54′ E) at *c*. 325 m above msl. The village is located on the northern side of a lake formed behind the Shah Nehar Barrage, in the outflow area of Pong Dam. There are many small ponds and marshy areas near the lake. At 12:30 hrs, I saw a plover with a grey head and neck, without a supercilium or black cap. Its grey breast was separated from the white belly by a broad black breast-band. It had a yellow beak with a black tip. On the basis of these features, the species was identified

as an adult Grey-headed Lapwing. It was seen feeding in the marsh for half an hour. It was shy and did not allow close approach. I took some photographs from a distance and left the place. The bird was not seen on my subsequent visits to the place.

Discussion

Grey-headed Lapwing is a regular winter visitor to the eastern plains from Central Nepal and Bihar through Assam, South Assam hills, all of Bangladesh, south-west Bengal, and Odisha. A significant portion of Uttar Pradesh is also shown in its distribution map by Grimmett *et al.* (2011), Rasmussen & Anderton (2012), and Wiersma & Kirwan (2018). A few individuals reach Delhi and Bharatpur, and it is a straggler to many other Indian states (Rasmussen and Anderton 2012). There have been so many sightings of Grey-headed Lapwing out of its regular range that Eriksen *et al.* (2015) suggested that it is a more common and widespread winter visitor to India than previously thought, occurring further west and particularly further south, than indicated on range maps. But it remains a vagrant to the neighbouring North Indian states. There is one historical sight record by Whistler from Kashmir (Baker 1929). In Uttarakhand, the species has been recorded from two places – one bird was recorded from Dehra Dun Valley for about a month, between 1946 and 1951 (Singh 2000; Wright 1955); and there are two records from Haripura Reservoir on River Baur, one in 2009 and other in December 2011 (Bhattacharjee and Kidwai 2013). In Haryana, the sightings are only from Sultanpur National Park and Basai, both located in Gurugram district, near Delhi (Harvey *et al.* 2006). There are no published records from Punjab. Grey-headed Lapwing has not been recorded from Himachal Pradesh (den Besten 2004; Dhadwal 2011; Grimmett *et al.* 2011), and the present record is the first record for the state. The bird seen at Sthana was probably in migration.

ACKNOWLEDGEMENTS

I thank Harkirat Singh Sangha for his comments on the manuscript and Manoj Sharma for help in references.

REFERENCES

Baker, E.C.S. (1929): The Fauna of British India, including Ceylon and Burma. Birds. Taylor and Francis, London. Vol. VI, pp. 191–192.

Bhattacharjee, A. & Z. Kidwai (2013): Sighting of Grey-headed Lapwing *Vanellus cinereus* at Haripura Reservoir in Uttarakhand, India. *J. Bombay Nat. Hist. Soc. 109(3)*: 201–202.

den Besten, J.W. (2004): Birds of Kangra. Moonpeak Publishers & Mosaic Books, Dharamsala & New Delhi, pp. 160–170.

Dhadwal, D.S. (2011): Wild Wings: Pong & its birds. Published by the author, pp. 135–145.

Eriksen, H., J. Eriksen, J. Victor & R. Victor (2015): A new record of Grey-headed Lapwing *Vanellus cinereus* in Goa and an update on its distribution in India. *BirdingASIA 23(June)*: 94–95.

Grimmett, R., C. Inskipp & T. Inskipp (1998): Birds of the Indian Subcontinent. Christopher Helm, A & C Black, London, pp. 496–497.

Grimmett, R., C. Inskipp & T. Inskipp (2011): Birds of the Indian Subcontinent. Oxford University Press & Christopher Helm, London, pp. 148.

Harvey, B., N. Devasar & B. Grewal (2006): Atlas of the Birds of Delhi and Haryana. Rupa & Co., New Delhi, pp. 311.

Rasmussen, P.C. & J.C. Anderton (2012): Birds of South Asia: The Ripley Guide. 2nd edn. Smithsonian Institution, Michigan State University and Lynx Edicions, Washington D.C., Michigan, and Barcelona. Vol. 2, pp. 158.

Singh, A.P. (2000): Birds of lower Garhwal Himalayas: Dehra Dun valley and neighbouring hills. *Forktail 16*: 101–123.

Wiersma, P. & G.M. Kirwan (2018): Grey-headed Lapwing (*Vanellus cinereus*). *In*: del Hoyo, J., A. Elliott, J. Sargatal, D.A. Christie & E. De Juana (Eds): Handbook of the Birds of the World Alive. Lynx Edicions, Barcelona. (Retrieved from https://www.hbw.com/node/53806 on July 4, 2018).

Wright, M.D. (1955): Notes on the birds of a selected area of Dehra Dun. June 1946 to December 1950. *J. Bombay Nat. Hist. Soc. 54(3)*: 627–662.

Recommended Citation

Abhinav, C. (2019): First record of Grey-headed Lapwing *Vanellus cinereus* from Himachal Pradesh, India. *J. Bombay Nat. Hist. Soc. 116*: 99–100. doi: 10.17087/jbnhs/2019/v116/131215

13. IS RED-WATTLED LAPWING *VANELLUS INDICUS* A PISCIVORE?

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[1]Accepted January 11, 2019
First published: June 28, 2019 | doi: 10.17087/jbnhs/2019/v116/122813
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Red-wattled Lapwing *Vanellus indicus* is a large wader belonging to the family Charadriidae. Paddy fields, river banks, lake beds and lateritic plains form the feeding habitat of Red-wattled Lapwing. Usually they are seen in pairs or small groups. The loud call "*did you do it"* is characteristic of this species. Red-wattled Lapwing is a ground-dwelling bird and a diurnal forager which feeds on a wide variety of insects, snails, and other invertebrates, mostly picked from the ground. While conducting behavioural studies of birds in Kole wetlands of Thrissur, Kerala (10° 20′–10° 40′ N; 75° 58′–76° 11′ E), on October 07, 2017, around 09:20 hours, a Red-wattled Lapwing was seen catching a fish from the water (water depth 10 cm) from Adatt Kole (10° 32′ 11.77″ N; 76° 08′ 22.3″ E), Thrissur. A flock of three Red-wattled Lapwings was seen standing in the rocky area in the wetlands, facing the sun. One among the flock waded into the water which was covered with floating vegetation, caught a fish *Puntius amphibius* from the water (Fig. 1), held it for about three minutes and then swallowed it. Studies regarding nest building (Sharma 1992), interaction between dog and Red-wattled Lapwing (Bhatnagar 1978), belly-soaking and nest wetting behaviour (Sundararaman 1989), breeding behaviour (Kalsi and Khera 1990, 1992; Naik *et al.* 1961), insect feeding behaviour (Babi 1987), agonistic and distraction behaviour (Kalsi and Khera 1987) of Red-wattled Lapwing were described by earlier workers. Foraging studies on Red-wattled Lapwing are scanty, compared to breeding and nesting studies. During April to October, paddy fields are flooded, submerging the foraging ground. The increased population after the breeding (March–June) and reduced foraging ground may lead to the depletion of food items with high protein content. In order to take in substitutes for its protein requirements, Red-wattled Lapwing could be changing to the observed piscivory.

Fig.1: Red-wattled Lapwing with its fish catch

ACKNOWLEDGEMENTS

The authors are grateful to the Director, KFRI, for facilities and infrastructure. We wish to thank Kerala State Council for Science, Technology, and Environment, for providing necessary financial support. Special thanks to Dr Nishad P.M., for rendering field support.

REFERENCES

Babi, A.Z. (1987): Feeding behaviour of Red-wattled Lapwing. *Newsletter for Birdwatchers 27(1–2)*: 15.

Bhatnagar, R.K. (1978): Interaction of a Redwattled Lapwing and a dog. *Newsletter for Birdwatchers 18(1)*: 9.

Kalsi, R.S. & S. Khera (1987): Agonistic and distraction behaviour of the Redwattled Lapwing *Vanellus indicus indicus. Pavo 25(1&2): 43–56.*

Kalsi, R.S. & S. Khera (1990): Growth and development of the Red-wattled Lapwing *Vanellus indicus. Stilt 17: 57–64.*

Kalsi, R.S. & S. Khera (1992): Some observations on maintenance behaviour of the Red-wattled Lapwing *Vanellus indicus* (Boddaert). *J. Bombay Nat. Hist. Soc. 89(3): 368–372.*

Naik, R.M., P.V. George & D.B. Dixit (1961): Some observations on the behaviour of the incubating Redwattled Lapwing *Vanellus indicus* (Bodd.). *J. Bombay Nat. Hist. Soc. 58(1)*: 223–230.

SHARMA, S.K. (1992): Use of droppings of Indian Hare for nest making by Redwattled Lapwing. *Newsletter for Birdwatchers 32(7&8)*: 19.

SUNDARARAMAN, V. (1989): Belly-soaking and nest wetting behaviour of Redwattled Lapwing, *Vanellus indicus* (Boddaert). *J. Bombay Nat. Hist. Soc. 86(2)*: 242.

Recommended Citation

Greeshma, P. and E.A. Jayson (2019): Is Red-wattled Lapwing *Vanellus indicus* a piscivore? *J. Bombay Nat. Hist. Soc. 116*: 101–102. doi: 10.17087/jbnhs/2019/v116/122813

14. OCCURRENCE OF ONE-LEGGED MARSH SANDPIPER *TRINGA STAGNATILIS* FLOCKS AT CHILIKA LAKE, ORISSA, INDIA[1]

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[1]Accepted June 12, 2019
First published: June 28, 2019 | doi: 10.17087/jbnhs/2019/v116/145452
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As part of a project titled "Population monitoring of waterbirds at Chilika Lake and Bhitarkanika with special reference to avian influenza", funded by Wildlife Division, Government of Orissa, waterbird population monitoring was carried out at Chilika Lake (19° 28′–19° 54′ N; 85° 05′–85° 38′ E) from the first week of December 2005 to the second week of April 2006. From the last week of December, we started observing some sick and dead birds at Nalabana Bird Sanctuary (19° 28′–19° 54′ N; 85° 05′–85° 38′ E), an island within Chilika Lake with an extent of 15.53 sq. km which gets completely submerged in monsoon. Thereafter, we restricted our field activities mostly to Nalabana Island, where we started collecting dead birds for disposal and sick birds for antibiotic treatment, in collaboration with the Wildlife Department of Orissa (now Odisha). On January 06, 2006, we collected a total of 88 dead birds of 11 species and 59 sick birds of nine species. On the same day, while looking for dead and sick birds, we came across two small flocks of Marsh Sandpiper *Tringa stagnatilis*. Most of the birds in these flocks were limping in the water within a few metres distance from us. When we observed the flocks through a telescope, we were astonished to find that out of 49 and 23 individuals recorded in the first and second flocks, 39 and 15 birds, respectively had only one leg. We went close to the flocks, and caused a minor disturbance to them. They flew a few metres and landed on one leg only, and started limping when we moved closer to them. We could confirm without doubt that all of them had one leg only. Prater *et al.* (1977) stated that Marsh Sandpiper is a medium to long distance migrant. It breeds in Southeast Europe, Central and South Russia, and across middle Asia south of latitude 56°, as far as east to Transbaikalia, south to Turkestan and North Mongolia. It migrates to Africa, Arabia, India, Myanmar, Indochinese countries, Sunda Islands and the Moluccas, to Australia for wintering (Ali and Ripley 1983). As these birds are migrants from the farthest North, the presence of one-legged birds in a flock moving together on migration is quite interesting. Manakadan (1991) recorded nine one-legged Common Greenshank *Tringa nebularia* in a flock of 15 birds at Point Calimere. While ringing, we have occasionally ringed a few individuals of common waders such as Curlew Sandpiper *Calidris ferruginea*, Little Stint *Calidris minuta*, Lesser Sand Plover *Charadrius mongolus*, and Redshank *Tringa totanus* from various places over several years, which were one-legged or with deformed legs. Though we have observed a few individuals (two to four) of similar species with one leg in the field, this is the largest flock of one-legged waders ever observed. It is not known whether the flock formation of these one-legged birds happened at the wintering site or at the breeding site.

ACKNOWLEDGEMENTS

We are grateful to the late Mr J.C. Daniel, then Honorary Secretary and Director, BNHS, for going through the manuscript and for his valuable comments. We would like to express our sincere thanks to the Wildlife Department, Govt of Orissa, for funding the project, and Chief Wildlife Warden of Orissa for granting necessary permission for the study. We greatly appreciate the hard work rendered by our field assistants Mr P. Guruswamy and Mr Niranjan Dalei.

REFERENCES

Ali, S. & S.D. Ripley (1983): Handbook of the Birds of India and Pakistan together with those of Bangladesh, Nepal, Bhutan and Sri Lanka. Compact Edition. Oxford University Press, New Delhi.

Manakadan, R. (1991): A flock of one-legged Greenshanks *Tringa nebularia*. *J. Bombay Nat. Hist. Soc. 88(3)*: 451–452.

Prater, A.J., J.H. Marchant & J. Vuorinen (1977): Guide to the identification and ageing of Holarctic waders. B.T.O. Guide 17. Tring, England.

Recommended Citation

Sathiyaselvam, P. and S. Balachandran (2019): Occurrence of one-legged Marsh Sandpiper *Tringa stagnatilis* flocks at Chilika Lake, Orissa, India. *J. Bombay Nat. Hist. Soc. 116*: 102–103. doi: 10.17087/jbnhs/2019/v116/145452

15. NOTES ON THE OCCURRENCE OF WESTERN HOODED PITTA *PITTA SORDIDA* IN HIMACHAL PRADESH, INDIA[1]

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[1]Accepted October 09, 2018
First published: April 30, 2019 | doi: 10.17087/jbnhs/2019/v116/130115
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Western Hooded Pitta *Pitta sordida* inhabits diverse habitats from primary riparian forests to dense bamboo jungles and commercial plantations (Erritzoe and Kirwan 2018). It is one of the six pitta species found within Indian limits and the second most widespread after the Indian Pitta *Pitta brachyura*. Two subspecies of the Western Hooded Pitta are known to occur in India. *P. sordida cucullata* distributed in mainland India along the foothills of Himalaya from Himachal east to Arunachal Pradesh and north-east Indian Hills; and *P. sordida abbotti*, resident in the Nicobar Islands. It is rather scarce and local in most of its Indian range except in the Nicobars (Rasmussen and Anderton 2012). This note describes sightings of the species from Col. Sher Jung National Park, Himachal Pradesh.

On June 23, 2017, the authors made a visit to Col. Sher Jung National Park (30.44° N; 77.47° E), also known as Simbalwara National Park, situated in the western limits of sal-dominated forests of Shivalik ranges in southern Himachal Pradesh. Having visited this protected area during winters previously, we wanted to document the breeding bird species of the area. We came across a host of habitats ranging from sal dominated moist deciduous forests to eucalyptus plantations, with the former being the most dominant.

At 10:35 hrs, we stumbled upon a mixed species flock moving along a patch of trees, sandwiched between the main dirt track of the Park and a stream (30.43° N; 77.49° E) at *c*. 490 m above msl. A few minutes later, we were startled by loud and distinct double whistles emanating from the other side of the stream. These were identified as calls of a Western Hooded Pitta. This was one of the species that we had expected to occur in the Park, and we had familiarized ourselves with its vocalizations. The bird kept calling as we approached this patch of secondary forest with one of its fringes dominated by eucalyptus. The undergrowth was primarily composed of dense thickets of *Lantana camara*. Just a few strides along this path, we clearly saw the bird with its bright blue wing patches (Fig. 1) on the otherwise green upperparts, before it finally dived into another patch of *Lantana*. Over the next few hours, we kept hearing the calls of three birds.

Fig. 1: Western Hooded Pitta recorded in Simbalwara National Park

On June 25, 2017, the last two authors made another visit to the Park and explored areas further ahead of the spot where the pittas were sighted previously. The birds were very vocal and five more birds were either heard or seen within the one kilometre distance walked. This stretch had mixed sal forest and the undergrowth was fairly heterogeneous, being composed of *Millettia extensa*, *Clerodendrum infortunatum*, and *Flemingia* sp. The birds kept to the thickets, and rarely exposed themselves.

Discussion

Our visits showed us that parts of the Park provide good habitat for the Western Hooded Pitta and that it was present in good numbers. It is possible that the species breeds in the area as the birds appeared to be holding territories. The pittas sighted on 25th June were observed in mixed patches of sal with a good assortment of native shrubs in the understorey. Contrastingly, on the first day, they were observed in secondary forests close to eucalyptus plantations where the undergrowth was rather scrubby, being dominated by *Lantana*. This is not surprising as the species is known to inhabit secondary forest with heavy understorey or scrub in parts of its range (Erritzoe and Kirwan 2018).

There have been surveys within the Park in the past across multiple habitats including eucalyptus plantations and eucalyptus-sal mixed forests (Bhargav *et al.* 2007), with sufficient effort also during the summer months. None of these surveys recorded the species from the Park. The birds that we came across were secretive but quite vocal, and they could be missed if one were not familiar with their calls. Similarly, the species was recorded in the adjoining Kalesar National Park, Haryana only in June 2017 (Kalsi *et al.* 2017), despite significant surveys since 1993 (Kalsi 1998; Sharma 2002). To the immediate east of Col. Sher Jung NP, the Hooded Pitta is reported from the low lying areas of Dehradun, but is by no means common. It finds no mention in the older checklists from the area (George 1957a,b; Osmaston 1935). The comprehensive checklist of the region by Singh (2000) lists it as rare, based on published records (Mohan 1997; Mohan and Chellam 1991). There have been a handful of scattered records recently in this region, but the species seems to be more common in the eastern parts of Uttarakhand (eBird 2018).

Historical records of this bird from Himachal Pradesh are not very definitive. A dead bird was found at Glen, Shimla on June 23, 1942 and handed over to A.E. Jones. Though the bird did not show any trace of having been in captivity, Jones remarked "One can only conjecture what brought it so far from its normal habitat..." (Jones 1943). Even if wild, one can only posit that it was a vagrant, since the area of record is dominated by Himalayan moist temperate forests composed of *Cedrus deodara, Quercus* sp., and *Rhododendron* sp. with a rather sparse understorey. There is a reported record from Western Himachal (Grimmett *et al.* 1998, 2011) but neither could we trace the record nor the authors (Tim Inskipp *in litt.,* email March 08, 2018).

Apart from being a case of 'rediscovery' of Western Hooded Pitta in Himachal Pradesh, our sighting in Col. Sher Jung National Park constitutes the first photographic record (Fig. 1) of the bird from the state. Similar habitats exist outside the Park, almost to *c.* 30 km west of it. It would be interesting to look out for these birds in the summer across this entire area to ascertain its breeding status, and to check if it also occurs in areas with higher anthropogenic pressure.

ACKNOWLEDGEMENTS

We thank Manoj Sharma for his comments on the manuscript, Tim Inskipp for his prompt response, and Siddharth Bhardwaj for company in the field.

REFERENCES

Bhargav, V.K., V.P. Uniyal, S. Kittur & K. Sivakumar (2007): Bird records from Simbalbara Wildlife Sanctuary, Himachal Pradesh. *Indian Forester 133(10)*: 1411–1418.

eBird (2018): eBird Range Map--Hooded Pitta. Retrieved from https://ebird.org/map/ on June 09, 2018.

Erritzoe, J. & G.M. Kirwan (2018): Western Hooded Pitta (*Pitta sordida*). *In*: del Hoyo, J., A. Elliott, J. Sargatal, D.A. Christie & E. de Juana (Eds): Handbook of the Birds of the World Alive. Lynx Edicions, Barcelona. Retrieved from https://www.hbw.com/node/57570 on June 09, 2018.

George, J. (1957a): Birds of New Forest. *Indian Forester 83(11)*: 674–687.

George, J. (1957b): Birds of New Forest. *Indian Forester 83(12)*: 724–737.

Grimmett, R., C. Inskipp & T. Inskipp (1998): Birds of the Indian Subcontinent. Christopher Helm, A & C Black. London. Pp. 888.

Grimmett, R., C. Inskipp & T. Inskipp (2011): Birds of the Indian Subcontinent. Oxford University Press & Christopher Helm. London. Pp. 528.

Jones, A.E. (1943): On the occurrence of the Green-breasted Pitta (*Pitta cucullata* Hartl.), at Simla. *J. Bombay Nat. Hist. Soc. 43(4)*: 658.

Kalsi, R.S. (1998): Birds of Kalesar Wildlife Sanctuary, Haryana, India. *Forktail 13*: 29–32.

Kalsi, R.S., S.C. Sharma & J.R. Choudhary (2017): Hooded Pitta *Pitta sordida* in Kalesar National Park, Haryana, India. *Indian BIRDS 13(5)*: 137–138.

Mohan, D. (1997): Birds of New Forest, Dehra Dun, India. *Forktail 12*: 19–30.

Mohan, D. & R. Chellam (1991): New call record of Green-breasted Pitta *Pitta sordida* (P.L.S. Muller) in Dehra Dun, Uttar Pradesh.

J. Bombay Nat. Hist. Soc. 87(3): 453–454.
OSMASTON, B.B. (1935): Birds of Dehra Dun and adjacent hills. *Indian Military Academy Journal* 1935 (June): 1–52.
RASMUSSEN, P.C. & J.C. ANDERTON (2012): Birds of South Asia: the Ripley Guide. 2nd edn. 2 vols. Smithsonian Institution, Michigan State University and Lynx Edicions. Washington D.C., Michigan, and Barcelona. Pp. 378 & 683.
SHARMA, S.C. (2002): Birds of Kalesar Wildlife Sanctuary (Haryana) (An Un-annotated Checklist). (Retrieved from http://www.delhibird.com/Checklists/Kalesar.html on June 09, 2018).
SINGH, A.P. (2000): Birds of lower Garhwal Himalayas: Dehra Dun valley and neighbouring hills. *Forktail 16*: 101–123.

Recommended Citation

Vikrant, Ankit, C. Abhinav and Piyush Dogra (2019): Notes on the occurrence of Western Hooded Pitta *Pitta sordida* in Himachal Pradesh, India. *J. Bombay Nat. Hist. Soc. 116*: 103–105. doi: 10.17087/jbnhs/2019/v116/130115

16. RECORDS OF AVIAN BEAK DEFORMITIES IN PUNJAB, INDIA[1]

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[1]Accepted March 27, 2019
First published: August 30, 2019 | doi: 10.17087/jbnhs/2019/v116/142214
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The avian beak is an external keratinized structure used for feeding, preening, manipulating objects, and feeding young. The avian beak shows remarkable adaptations for foraging on different types of food. Beak deformities reduce the bird's ability to feed and preen, making it more susceptible to infection by ectoparasites (Zylberberg *et al.* 2018). This

Fig. 1: House Crow with nodule-like formation on beak

Fig. 2: House Crow with hooked beak

Fig. 3: Common Myna with a longer upper mandible, feeding by turning its head sideways

Fig. 4: Common Myna with longer lower mandible

short communication pertains to the observations on beak deformities in House Crow *Corvus splendens* and Common Myna *Acridotheres tristis* in Jalandhar and Ludhiana cities of the state of Punjab, India.

A House Crow *Corvus splendens* was recorded at Dashmesh Nagar, Ludhiana, on January 03, 2019, that had a nodule-like keratinization at the tip of the upper mandible, and one foot missing (Fig. 1); it had matted feathers as it was unable to preen due to the beak deformity. Another House Crow with beak deformity was observed in Punjab Agricultural University campus, Ludhiana on January 06, 2019. This crow had a hooked beak with long and curved upper mandible (Fig. 2), however, it was able to feed itself. A similar observation on house crow was made in Dashmesh Nagar, Ludhiana, on January 28, 2019. This crow had a longer and more curved upper mandible. It was being fed by another House Crow, probably its mate. The crow did not associate with the flock, and remained only in the company of its partner.

A Common Myna with a deformed bill was recorded in Model Town market, Jalandhar, on July 28, 2018. It had a longer upper mandible, but was able to pick up food by turning its head to one side (Fig. 3). It was observed feeding its juvenile, which had a normal beak. A similar beak deformity in common myna was reported by Pandey and Jangid (2018) in Ajmer, Rajasthan. In another observation, a common myna with a longer lower mandible was once seen (Fig. 4) at the Sports and Surgical Complex, Jalandhar on February 10, 2019.

Beak abnormalities in birds may arise due to defective bone growth, misalignment of maxilla and mandible, wear and tear of rhamphotheca, malnutrition, infections, mutations, teratogenesis or injury (Handel *et al.* 2010; Olsen 2003). Avian keratin disorder (AKD) is an epizootic of beak deformities which was first documented in Black-capped Chickadees *Poecile atricapillus* in Alaska during the late 1990s (Zylberberg *et al.* 2018). Bill deformities can take many forms, with upper and/or lower mandible elongated or curved either upwards or downwards, while in some cases the mandibles may be crossed (Craves 1994). Some birds might adjust to these deformities, or get help from conspecifics. In wild birds, beak deformities are rare with only individual accounts, whereas in caged birds, beak abnormalities are relatively common due to lack of wear. Among wild birds, beak deformities have been observed to be particularly common in corvids, cavity-nesting passerines, and raptors in North America (Handel *et al.* 2010; van Hemert and Handel 2010).

Other than our record of bill deformities observed in Punjab, a literature search revealed that there is only a single published paper (Kasambe *et al.* 2009) reporting on bill deformities in India. This phenomenon needs to be studied, especially with the drastic anthropogenic developmental changes taking place in India's landscape, which affect birds.

REFERENCES

Craves, J.A. (1994): Passerines with deformed bills. *North American Bird Bander 19(1)*: 14–18.

Handel, C.M., L.M. Pajot, S.M. Matsuoka, C.V. Hemert, J. Terenzi, S.L. Talbot, D.M. Mulcahy, C.U. Meteyer & K.A. Trust (2010): Epizootic of beak deformities among wild birds in Alaska: an emerging disease in North America? *The Auk 127(4)*: 882–898.

Kasambe, R., A. Joshi & S. Meppayur (2009): Bill deformities in House Crow *Corvus splendens*, Large-billed Crow *C. macrorhynchos* and Yellow-billed Blue Magpie *Urocissa flavirostris* in India. *Newsletter for Birdwatchers 49(5)*: 73–77.

Olsen, G.H. (2003): Oral biology and beak disorders of birds. *Veterinary Clinics of North America*: *Exotic Animal Practice 6(3)*: 505–521.

Pandey, D.D. & A.K. Jangid (2018): Beak abnormality in Common Myna *Acridotheres tristis* (Linnaeus, 1766). *Bio Bulletin 4(1)*: 35–36.

van Hemert, C. & C.M. Handel (2010): Beak deformities in northwestern crows: evidence of a multispecies epizootic. *The Auk 127(4)*: 746–751.

Zylberberg, M., C.V. Hemert, C.M. Handel & J.L. Derisi (2018): Avian keratin disorder of Alaska black-capped chickadees is associated with Poecivirus infection. *Virology Journal 15(1)*:100.

Recommended Citation

Soni, Shivangi, Navleen Kaur Sahni and Tejdeep Kaur Kler (2019): Records of avian beak deformities in Punjab, India. *J. Bombay Nat. Hist. Soc. 116*: 105–106. doi: 10.17087/jbnhs/2019/v116/142214

17. VERTEBRATE PREDATION BY JUNGLE MYNA *ACRIDOTHERES FUSCUS MAHRATTENSIS*[1]

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[1]Accepted June 07, 2019
First published: December 31, 2019 | doi: 10.17087/jbnhs/2019/v116/137326
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Introduction

Members of the family Sturnidae (starlings and mynas) are mostly omnivorous, although the importance and proportion of different categories of food (e.g. fruit, seeds, insects) to the diet can vary between species and seasons. The diet of the Jungle Myna *Acridotheres fuscus* consists of "insects, fruit, seeds and nectar" (Ali 1999; Craig and Feare 2009; Feare and Craig 1998). Here, I report a case of Jungle Myna feeding its nestlings a vertebrate (gecko).

Observations

At 15:00 hrs on July 18, 2018 on the backwaters near Alleppey (=Alappuzha, 9° 32′ 25″ N, 76° 25′ 24″ E) in Kerala, India, my attention was drawn to the begging calls of young birds within a hollow in the trunk of a dead coconut palm, *c.* 5 m above the ground. Shortly afterwards, an adult Jungle Myna *Acridotheres fuscus* arrived and perched on the palm, which was close to a houseboat. For the next 20 minutes, until the houseboat departed, the myna perched on fronds of surrounding palms, getting within 10 m of the nest and retreating approximately 20 m on multiple occasions. The adult was observed carrying a small gecko and a large spider in its bill. The bird sat there (Fig. 1), waiting for the boat to depart before going to feed its nestlings.

Fig. 1: Jungle Myna with gecko and spider, waiting to feed nest-dependent young

Discussion

The breeding observed here is later than that described by Feare and Craig (1998) and Ali (1999) for the southern Jungle Myna *Acridotheres fuscus mahrattensis*, who suggest the breeding season in southern India is from February to May (April to June-July further north).

Reviews of the diet of Jungle Myna (e.g. Narang and Lamba 1982; Feare and Craig 1998; Craig and Feare 2009; Karim and Ahsan 2016) did not report vertebrate prey and spiders in the species' diet. A detailed study on the diet of Jungle Myna through analysis of stomach contents (Narang and Lamba 1982) recorded the presence of grasshoppers, mole crickets, crickets, termites, beetles, ants, caterpillars, bugs, and dipteran larvae.

Small reptiles have, however, been recorded taken occasionally by other members of Sturnidae. Feare and Craig (1998) list 13 of the nearly 120 species of Sturnidae taking lizards, geckos, or skinks, namely 1. Red-winged Starling *Onychognathus morio*, 2. Wattled Starling *Creatophora cinerea*, 3. Splendid Glossy Starling *Lamprotornis splendidus*, 4. Greater Blue-eared Glossy Starling *L. chalybaeus*, 5. African Pied Starling *L. bicolor*, 6. White-cheeked Starling *Spodiopsar cineraceus*, 7. Common Hill Myna *Gracula religiosa*, 8. Common Starling *Sturnus vulgaris*, 9. Spotless Starling *S. unicolor*, 10. Black-bellied Glossy Starling *Notopholia corusca*, 11. Bali Myna *Leucopsar rothschildi*, 12. Common Myna *Acridotheres tristis*, 13. Collared Myna *A. albocinctus* (see also Beasley 1978; Bertram 1976; Dean 1978; Delpy 1972; da Rosa Pinto and Lamm 1956; Mungure 1973). The Javan Myna *A. javanicus* is also known to prey on geckos (Lim 2013; Meng 2015).

Compared to other members of Sturnidae, Feare and Craig (1998) suggest *Acridotheres* mynas are opportunists and have a more omnivorous diet, involving a much higher proportion of insects and other animal matter. Bertram (1974) noted the diet of the Common Hill Myna *Gracula religiosa* as "also includes lizards, which together with insects, are taken especially when feeding young". Further observations of the diet of Jungle Myna (and other *Acridotheres* species)

feeding young could determine whether there are seasonal dietary changes in this species, and whether small reptiles are more regular components of the food fed to the young during the breeding season.

REFERENCES

Ali, S. (1999): Birds of Kerala. 3rd edn. Kerala Forests and Wildlife Department, Thiruvananthapuram.

Beasley, A. (1978): Red-winged Starling preying on lizard. *Honeyguide 95*: 44.

Bertram, B. (1976): The voice of the Indian Hill Myna (*Gracula religiosa*) in the wild. *J. Bombay Nat. Hist. Soc. 71(3)*: 405–413.

Craig, A.J.F.K. & C.J. Feare (2009): Family Sturnidae (Starlings). Pp. 654–758. *In*: Handbook of the Birds of the World, Vol. 14: Bush-shrikes to Old World Sparrows (Eds: J. del Hoyo, A. Elliott & D.A. Christie). Lynx Edicions, Barcelona.

da Rosa Pinto, A.A. & D.W. Lamm (1956): Contribution to the study of ornithology of Sul do Save (Mozambique). Part III. *Memorias do Museu Dr Alvaro de Castro 4*: 107–167.

Dean, W.R.J. (1978): Plumage, reproductive condition and moult in non-breeding Wattled Starlings. *Ostrich 49*: 97–101.

Delpy, K.H. (1972): Über den Grünschwanzglanzstar (*Lamprotornis chalybeus*). *Gefiederte Welt 96*: 124–125.

Feare, C. & A. Craig (1998): Starlings and Mynas. Christopher Helm, London.

Karim, M.R. & M.F. Ahsan (2016): Breeding biology of Jungle Myna *Acridotheres fuscus* at Chittagong University Campus, Chittagong, Bangladesh. *Forktail 32*: 98–99.

Lim, J. (2013): Javan Myna takes a gecko. Bird Ecology Study Group, Singapore. http://www.besgroup.org/2013/12/06/javan-myna-takes-a-gecko/

Meng, C.Y. (2015): Javan Myna caught a Spotted House Gecko. Bird Ecology Study Group, Singapore. http://www.besgroup.org/2015/05/22/javan-myna-caught-a-spotted-house-gecko/

Mungure, S.A. (1973): Nest of Red-winged Starling *Onychognathus morio*. *East African Natural History Society Bulletin* (April): 52.

Narang, M.L. & B.S. Lamba (1982): A contribution to the food habits of the Grey-headed Myna, *Sturnus malabaricus malabaricus* (Gmelin). *Indian Journal of Forestry 5*: 24–29.

Recommended Citation

Fitzsimons, James A. (2019): Vertebrate predation by Jungle Myna *Acridotheres fuscus mahrattensis*. *J. Bombay Nat. Hist. Soc. 116*: 107–108. doi: 10.17087/jbnhs/2019/v116/137326

18. WHITE-BROWED TIT-WARBLER *LEPTOPOECILE SOPHIAE* BREEDING IN NORTH-WESTERN ARUNACHAL PRADESH, INDIA[1]

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[1]Accepted November 27, 2019
First published: December 31, 2019 | doi: 10.17087/jbnhs/2019/v116/147005

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White-browed Tit-Warbler *Leptopoecile sophiae* is a trans Himalayan species that occurs along the mountain chain from extreme north-western Himalaya to eastern Tibet. While the nominate subspecies occurs in Baltistan and Ladakh in the north-west of its range, the subspecies *obscurus* has been documented from central Nepal (Harrap 2019; Rasmussen and Anderton 2012).

On April 18, 2019, we were exploring the upper reaches of Tawang district, Arunachal Pradesh, on the road towards Bum La from Tawang, in search of higher altitude birds of Eastern Himalaya. The area that we were in was not far from the site where Crested Tit-Warbler *Leptopoecile elegans* was discovered in 2006 (Sangha *et al.* 2006), hence both these tit-warblers were on our radar during the trip. Much of the area was snow-covered, with small patches of dwarf rhododendron occurring in pockets. In one particularly large patch (27.68° N, 91.87° E), we stopped to scan for birdlife at 07:55 hrs and sighted a White-browed Tit-Warbler at about 50 m below the road, on rhododendron bushes (Praveen 2019a). Soon its mate joined in and they were making regular sorties towards a particular clump of dwarf rhododendron at about 1.0–1.5 m above the ground towards the upper part of the bush. This continued for some time and it was evident that the birds were building their ball-like nest with dry leaves and some dark material (which was difficult to discern from the distance). We made no attempt to go closer, but took a few photographs and a video from a distance and left the place. On our return journey from Bum La, when we went past the area,

the pair was still around, active near the nest (Praveen 2019b).

On both the occasions, the birds were not shy or retiring – sitting on open perches like prinias, and moving quickly from clump to clump. Each sortie to the nest lasted only 10–15 seconds. The patch itself was not vast, and had there been more tit-warblers demonstrating this behaviour, we would have found them. According to Harrap (2019), these birds are known to nest communally sometimes. The birds did not call while we were there, or we were too far from the birds to hear them. Identification of this species was straightforward – dark chestnut cap, short white supercilium, and bluish underparts – as clearly evident in the field through the spotting scope, and any confusion with species like Grey-sided Bush-Warbler *Cettia brunnifrons* and Crested Tit-Warbler *Leptopoecile elegans* can be discarded on the basis of their discernible plumage differences.

Presence of White-browed Tit-Warbler in the Indian subcontinent east of Nepal is recent knowledge, with no historical records from Sikkim, Bhutan, or Arunachal Pradesh (Ali and Ripley 1987; Rasmussen and Anderton 2012). Grimmett *et al.* (2011) mention one summer record from north-western Arunachal – probably based on Choudhury (2006). Grimmett *et al.* (2019) include Sela region and Tawang district, apart from two sites in Bhutan, in the species distribution map – possibly based on new records from online forums. Photographs in online forums (Basumatary 2017; Islam 2018a, b; Meppayur 2019) indicate that the race found in this region is the darker *obscurus* and our breeding record establishes it as a resident in Tawang district, and not a wanderer from the Tibetan facies.

REFERENCES

Ali, S. & S.D. Ripley (1987): Compact Handbook of the Birds of India and Pakistan together with those of Bangladesh, Nepal, Bhutan and Sri Lanka. 2nd edn. Oxford University Press, Delhi.

Basumatary, R. (2017): Website URL: https://ebird.org/view/checklist/S39186557 Accessed on July 13, 2019.

Choudhury, A. (2006): A Pocket Guide to the Birds of Arunachal Pradesh. Gibbon Pocket Guides. Gibbon Books & The Rhino Foundation for Nature in NE India. Guwahati. 109 pp.

Grimmett, R., C. Inskipp & T. Inskipp (2011): Birds of the Indian Subcontinent. Helm Field Guides. Oxford University Press & Christopher Helm, London. 528 pp.

Grimmett, R., C. Inskipp, T. Inskipp & Sherub (2019): Birds of Bhutan and the Eastern Himalayas. Helm Field Guides. Christopher Helm, London. 416 pp.

Harrap, S. (2019): White-browed Tit-warbler (*Leptopoecile sophiae*). *In*: del Hoyo, J., A. Elliott, J. Sargatal, D.A. Christie & E. de Juana (Eds): Handbook of the Birds of the World Alive. Lynx Edicions, Barcelona. Retrieved from https://www.hbw.com/node/59753 on July 13, 2019.

Islam, R. (2018a): EBird Checklist S46819891. https://ebird.org/view/checklist/S46819891 Accessed on July 13, 2019.

Islam, R. (2018b): White-browed Tit-Warbler. http://www.orientalbirdimages.org/search.php?Bird_ID=1838&Bird_Image_ID=165505 Accessed on July 13, 2019.

Meppayur, S. (2019): Website URL: https://ebird.org/india/view/checklist/S57581150 Accessed on July 13, 2019

Praveen, J. (2019a): Website URL https://ebird.org/india/view/checklist/S55419138 Accessed on July 13, 2019.

Praveen, J. (2019b): Website URL https://ebird.org/india/view/checklist/S55419144 Accessed on July 13, 2019.

Rasmussen, P.C. & J.C. Anderton (2012): Birds of South Asia: The Ripley Guide. Smithsonian Institution, Washington DC, Michigan State University, Michigan, and Lynx Edicions, Barcelona.

Sangha, H.S., R. Naoroji & M. Sharma (2007): The Crested Tit-warbler *Leptopoecile elegans* in north-west Arunachal Pradesh. An addition to the Indian avifauna. *IndianBIRDS 3(1)*: 23–25.

Recommended Citation

Praveen, J., Dipu Karuthedathu, Vinay Das and Vijay Ramachandran (2019): White-browed Tit-Warbler *Leptopoecile sophiae* breeding in north-western Arunachal Pradesh, India. *J. Bombay Nat. Hist. Soc. 116*: 108–109. doi: 10.17087/jbnhs/2019/v116/147005

19. FIRST RECORD OF CHINESE RUBYTHROAT *CALLIOPE TSCHEBAIEWI* FROM HIMACHAL PRADESH, INDIA[1]

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[1]Accepted October 19, 2018
First published: March 29, 2019 | doi: 10.17087/jbnhs/2019/v116/130855

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Until recently the White-tailed Rubythroat *Calliope pectoralis* was recognised as having four subspecies *C. p. pectoralis*, *C. p. bailloni*, *C. p. confusa*, and *C. p. tschebaiewi* (Ali and Ripley 1987; Grimmett *et al.* 2011; Rasmussen

Fig. 1: Chinese Rubythroat *Calliope tschebaiewi* with a large red throat patch and white submoustachial stripe distinctly visible

and Anderton 2012). Liu *et al.* (2016) showed that there are sufficient molecular, vocalization, and morphological differences to consider *tschebaiewi* as a separate species, and suggested the name Chinese Rubythroat for *C. tschebaiewi* and Himalayan Rubythroat for *C. pectoralis*. The split has been accepted by Clements *et al.* (2017), Praveen *et al.* (2018), and del Hoyo *et al.* (2018).

A male Chinese Rubythroat can be differentiated from Himalayan Rubythroat by a prominent white submoustachial stripe, finer white supercilia that do not meet above bill, larger red throat patch, narrower black breast-band, dark flecks on belly and flanks, and less white in the tail. There is also a difference in habitat, as the Chinese Rubythroat breeds in alpine and subalpine bushes, while the Himalayan Rubythroat breeds in lower lying deciduous and mixed forest (Rasmussen and Anderton 2012; del Hoyo *et al.* 2018). This note describes the sighting of a Chinese Rubythroat from Spiti Valley, Himachal Pradesh.

On September 22, 2017, the authors visited Shichling village, about 25 km from Kaza, Lahaul Spiti district, Himachal Pradesh (32° 04′ N; 78°13′ E) at *c.* 3,410 m above msl. There is a willow and poplar plantation, along Spiti river, *c.* 1 km in length with a maximum width of *c.* 200 m, with ample growth of *Hippophae* and a stream running through it. At 10:10 hrs, a rubythroat was seen inside dense growth of *Hippophae*. It was observed briefly before it disappeared in the undergrowth. The bird reappeared after a while on a low branch of a tree and was photographed. A white submoustachial stripe, large red throat patch, and black breast band were seen clearly. The prominent white submoustachial stripe and larger red throat patch ruled out Himalayan Rubythroat. Siberian Rubythroat *Calliope calliope* has similar facial pattern, but this rubythroat was overall darker, with much greyer upperparts (Siberian Rubythroat is more brown), black breast band (Siberian Rubythroat shows only a thin black line around the red throat patch), and white in the tail. Thus, it was identified as Chinese Rubythroat. It was seen again on September 29, 2017, near the same place (Fig. 1), feeding along a stream.

Chinese Rubythroat breeds in extreme eastern Kashmir, southern, eastern, and north-eastern Tibetan Plateau, Central China, and extreme northern Myanmar. It winters in the foothills of eastern Nepal, north-east India, northern Myanmar, and southern Yunnan (Clement and Rose 2015; del Hoyo *et al.* 2018). The presence of this species in Spiti is not unexpected, as the area has very similar topography to the adjacent regions of eastern Ladakh and the Tibetan Plateau, where the bird is known to breed (del Hoyo *et al.* 2018; Pfister 2004). Both Himalayan and Chinese Rubythroat breed in Ladakh (Pfister 2004), but only Himalayan Rubythroat has been documented in the adjacent Lahaul Valley (Auerbach 2017; Whistler 1925). Chinese Rubythroat has not been mentioned in previous works from Spiti Valley (Koelz 1937; Mahajan and Mukherjee 1974; Pandey 1989; Singh 2003; Whistler 1923). Thakur and Mattu (2011) have mentioned *Luscinia pectoralis* from Spiti without mentioning subspecies. However, they have mentioned many unlikely species like Himalayan Swiftlet *Aerodramus brevirostris*, Brown-flanked Bush Warbler *Horornis fortipes*, and Grey Bushchat *Saxicola ferrea* as 'very common' to 'common' and have mentioned several other unlikely species like Eurasian Treecreeper *Certhia familiaris* (now Hodgson's Treecreeper *C. hodgsoni* after split), Grey Treepie *Dendrocitta formosae*, and Olive-backed Pipit *Anthus hodgsoni* without further details, while missing commoners like Mountain Chiffchaff *Phylloscopus sindianus.* So the record of Thakur and Mattu (2011) needs to be further reviewed. The present record is the first record of the Chinese Rubythroat from the state of Himachal Pradesh.

ACKNOWLEDGEMENTS

We thank Manoj Sharma for his comments on the manuscript.

REFERENCES

Ali, S. & S.D. Ripley (1987): Compact Handbook of the Birds of India and Pakistan together with those of Bangladesh, Nepal, Bhutan and Sri Lanka. 2nd edn. Oxford University Press, Delhi. Pp. 567.

Auerbach, A. (2017): ebird. Retrieved from https://ebird.org/view/

checklist/S39042078 on July 10, 2018.

CLEMENT, P. & C. ROSE (2015): Robins and Chats. Christopher Helm, London. Pp. 288–291.

CLEMENTS, J.F., T.S. SCHULENBERG, M.J. ILIFF, D. ROBERSON, T.A. FREDERICKS, B.L. SULLIVAN & C.L. WOOD (2017): The eBird/ Clements checklist of birds of the world: v2017. Retrieved from http://www.birds.cornell.edu/clementschecklist/download/ Accessed on July 10, 2018.

DEL HOYO, J., N. COLLAR & D.A. CHRISTIE (2018): Chinese Rubythroat (*Calliope tschebaiewi*). *In*: del Hoyo, J., A. Elliott, J. Sargatal, D.A. Christie & E. De Juana (Eds): Handbook of the Birds of the World Alive. Lynx Edicions, Barcelona. Retrieved on July 10, 2018 from https://www.hbw.com/node/1344062.

GRIMMETT, R., C. INSKIPP & T. INSKIPP (2011): Birds of the Indian Subcontinent. Oxford University Press & Christopher Helm, London. Pp. 418.

KOELZ, W. (1937): Notes on the birds of Spiti, a Himalayan province of the Punjab. *Ibis 79(1)*: 86–104.

LIU, Y., G. CHEN, Q. HUANG, C. JIA, G. CAREY, P. LEADER, Y. LI, F. ZOU, X. YANG, U. OLSSON & P. ALSTRÖM (2016): Species delimitation of the White-tailed Rubythroat *Calliope pectoralis* complex (Aves, Turdidae) using an integrative taxonomic approach. *J. Avian Biol. 47(6)*: 899–910.

MAHAJAN, K.K. & R. MUKHERJEE (1974): Brief note on some observations at Lahaul and Spiti, H.P. *Newsletter for Birdwatchers 14(12)*: 3–4.

PANDEY, S. (1989): Some observations on the birds of Pin Valley National Park. *Newsletter for Birdwatchers 29(1–2)*: 9.

PFISTER, O. (2004): Birds and Mammals of Ladakh. Oxford University Press, Karachi. Pp. 130.

PRAVEEN J., R. JAYAPAL & A. PITTIE (2018): Checklist of the Birds of India (v2.1) [Date of publication: March 31, 2018]. Retrieved from http://www.indianbirds.in/india/ on July 10, 2018.

RASMUSSEN, P.C. & J.C. ANDERTON (2012): Birds of South Asia: the Ripley Guide. 2nd edn. Vol. 2. Smithsonian Institution, Michigan State University, and Lynx Edicions, Washington D.C., Michigan, and Barcelona. Pp. 391–392.

SINGH, A.P. (2003): Birds of Tabo: a lesser known cold desert in the Western Himalaya. *J. Bombay Nat. Hist. Soc. 100(1)*: 152–154.

THAKUR, M.L. & V.K. MATTU (2011): Avifauna of Kaza area of Spiti (Himachal Pradesh), India. *International Journal of Science and Nature 2(3)*: 483–487.

WHISTLER, H. (1923): A note on the birds of Spiti. *Ibis 65(4)*: 611–629.

WHISTLER, H. (1925): The birds of Lahul, N.W. Himalaya. *Ibis 67(1)*: 152–208.

Recommended Citation

Abhinav, C. and Jainy Kuriakose (2019): First record of Chinese Rubythroat *Calliope tschebaiewi* from Himachal Pradesh, India. *J. Bombay Nat. Hist. Soc. 116*: 109–111. doi: 10.17087/jbnhs/2019/v116/130855

20. UNUSUAL DEATH OF AN OLIVE RIDLEY SEA TURTLE IN DHABALESWAR SEA BEACH, ODISHA, INDIA[1]

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[1]Accepted June 08, 2018
First published: February 28, 2019 | doi: 10.17087/jbnhs/2019/v116/101275
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The unnatural death of a gravid Olive Ridley Sea Turtle *Lepidochelys olivacea* (Eschscholtz, 1829) is highlighted in this report. The incident took place during a field visit to Dhabaleswar sea beach (19.223°N; 84.869° E), Odisha, India, along the coastal area of Bay of Bengal. The coastal areas of Odisha are well-known as the breeding ground of Olive Ridley Turtle (Pandav *et al.* 2006; Rajagopalan *et al.* 1996; Raut and Nandi 1986) (Fig. 1). Thousands of marine turtles, including Olive Ridleys, migrate to coastal areas of India every year to lay eggs. Both eggs and meat are quite palatable to humans as well as other natural predators such as jackals, feral pigs and dogs, birds, monitor lizards, etc. High protein and fat content of adult turtle meat have industrial value also (Marquez and Dissel 1982). Though trading of Olive Ridley Sea Turtle is banned under CITES Appendix I, poaching still continues for their meat, shell, leather, and eggs. Frequently published reports about the deaths of Olive Ridleys in newspapers and journals indicate that the unnatural death of this creature is not accidental but a regular occurrence. The aim of the present study is to generate awareness among local people and government authorities, to take precautionary measures to protect this vulnerable creature.

Dhabaleswar beach is a tourist spot near Brahmapur city in Ganjam district, Odisha, India. The "golden beach" of Dhabaleswar is not very distant from Gopalpur beach, a renowned tourist spot (Fig. 1). A severely wounded Olive Ridley Sea Turtle was noticed in Dhabaleswar beach on March 25, 2016 around 16:45 hrs. The specimen was photographed and general morphological characters were recorded. The specimen was about 67 cm in length. The head was small

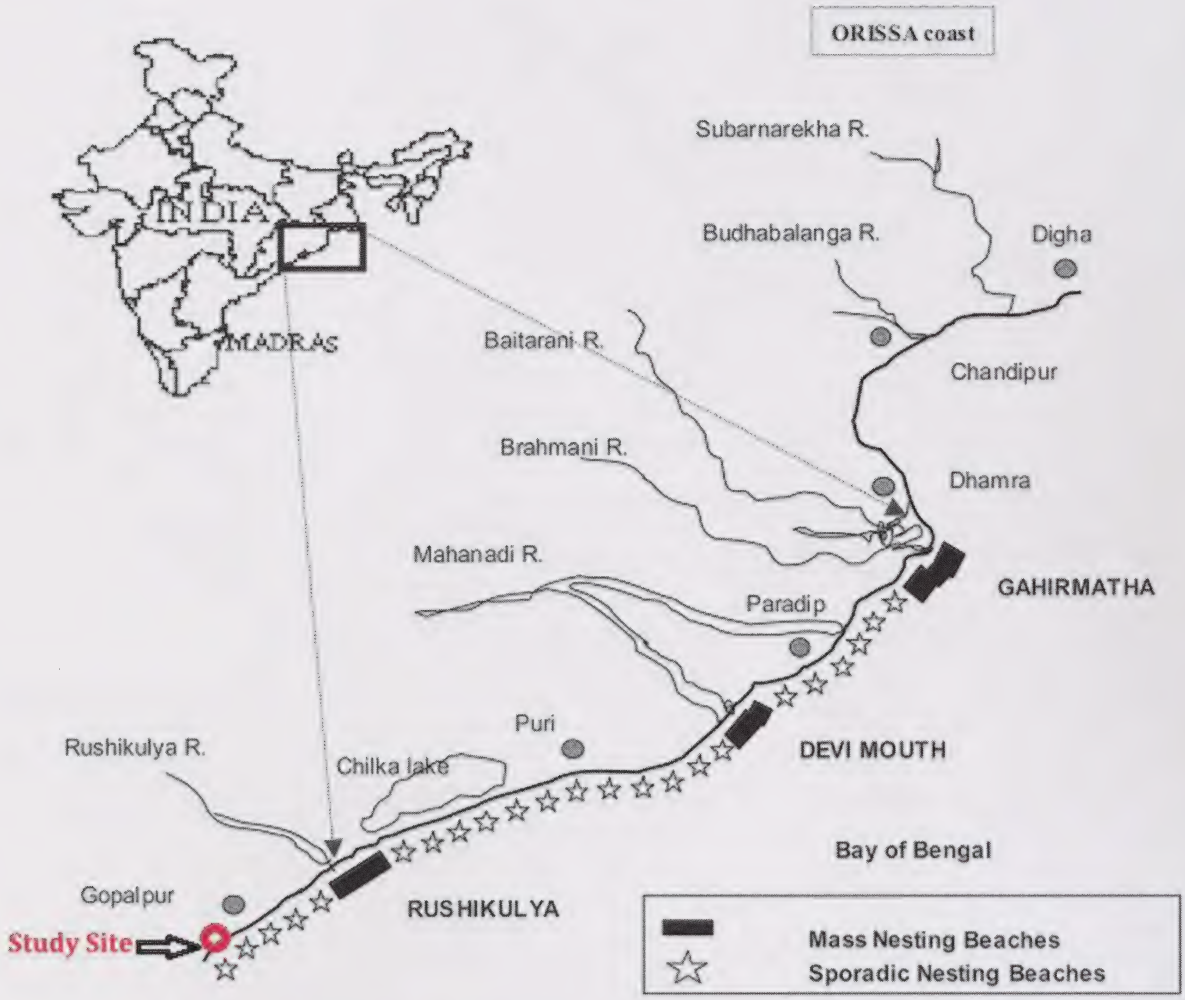

Fig. 1: Reported nesting sites of Olive Ridley Sea Turtle *Lepidochelys olivacea* along the coast of Odisha, India (Shanker and Kutty 2005). The present study site is shown as a red circle

and large scutes were present in the heart-shaped olive green carapace. There were eight smooth lateral scutes in the carapace. The dorsal part of the carapace was partly broken and the lateral side of the abdomen was fatally ruptured (Fig. 2a). About 20 eggs were scattered beside the animal (Figs 2b and 2c), which was bleeding heavily. The turtle died immediately and the eggs were scavenged and eaten up by a group of House Crow *Corvus splendens* (Vieillot, 1817) (Fig. 2d).

The specimen was identified as a mature gravid female Olive Ridley Sea Turtle *Lepidochelys olivacea*. The female may have been on its voyage for nesting, as Gopalpur and nearby sea beaches are reported to be sporadic nesting sites of the species (Shanker and Kutty 2005; Fig. 1).

Though there were many possible reasons for the unnatural death of this turtle, the nature of the injury on the dorsal side of the carapace indicates that it was hit by the propeller of a trawler, and wounds on the lateral side of the belly indicate injury from a fishing net. Trawlers which were seen nearby at the time of the incident strengthen the probability. The presence of the house crows to feed immediately on the eggs demonstrates the vulnerability of the eggs which would normally have been laid by this species.

Olive Ridleys, named after the eminent scholar-explorer H.N. Ridley, are the smallest marine turtles in the world. They are popularly known for the phenomenon of mass nesting called *arribada* in which thousands of females flock to the same beach to lay eggs. Another interesting phenomenon is that the females return to the same place where they were hatched, migrating thousands of miles from their feeding sites to their nesting sites. Olive Ridleys are found in the

Fig. 2: Olive Ridley Sea Turtle *Lepidochelys olivacea* found dead at Dhabaleswar beach, Odisha, India (a) Carapace partly broken and lateral side of abdomen fatally ruptured (b, c) Eggs scattered on the beach (d) House Crows feeding on the eggs

Pacific, Atlantic, and Indian Oceans. They nest along the coast of India and offshore islands, including Lakshadweep in the Arabian Sea and Andaman & Nicobar Islands in the Bay of Bengal (Kar and Bhaskar 1982). On the eastern coast, mass nesting of this turtle occurs at Gahirmatha, Devi, and Rushikulya in Odisha (Tripathi *et al.* 2008) (Fig. 1). Mass nesting occurs generally between February and March, though it may take place in late December or even in early April (Tripathi *et al.* 2008).

Olive Ridley populations are reported to be declining worldwide. *Arribada* rookeries are destroyed in Mexico and Surinam (Limpus 1995), Pakistan (Asrar 1999), Myanmar (Thorbjarnarson *et al.* 2000), Malaysia, and Thailand (Limpus 1995). In India, Olive Ridleys are on the decline in the coastal areas of Odisha (Bhupathy and Saravanan 2002) and Andaman & Nicobar Islands (Andrews *et al.* 2006). This species has been declared as Vulnerable by IUCN and included in Schedule I of the Indian Wildlife (Protection) Act 1972 (WPA) (Abreu-Grobois and Plotkin 2008). Factors responsible for the population decline on the Indian coast include beach erosion, incidental death during net trawling, illegal exploitation for meat and eggs, and uncontrolled beach tourism (Tripathi *et al.* 2008). There are several records to show that adult Olive Ridleys and their eggs were collected from Gahirmatha beach and were transported to Kolkata for trading. This mass hunting took place from prior to 1947 until the early 1980s (Kar 2001). Implementation of WPA 1972 ended the legal trade by the early 1980s (Kar and Dash 1984), but illegal poaching of sea turtles is continuing (http://www.seaturtle.org).

Trawl fisheries and the use of gillnets is a major problem for sea turtles in South Asia, including India (Giri and Chaturvedi 2003; Raut and Nandi 1986; Roychoudhury 2001; Subrata *et al.* 2013; Wright and Mohanty 2006). Every year, carcasses of Olive Ridley Sea Turtle are caught in fishing nets along the eastern coast of India, demonstrating high mortality in adult individuals (Wright and Mohanty 2006). Death of marine turtles due to collision with shipping vessels or trawlers has been reported frequently (Hazel and Gyuris 2006; Hazel *et al.* 2007; Sridhar 2005). The BBC website (http://www.bbc.com/news/world-asia-india-35369073) reported on January 21, 2016, the death of

more than 150 Olive Ridley turtles at Puri beach (19.808° N, 85.852° E) in Odisha, on the eastern coast, 150 km from Dhabaleswar. According to the local forest department officials, the turtles may have been hit by trawlers fishing along the Puri beach. The forest officials also added that local fishermen often flout the ban on fishing along the coast, disturbing the natural nesting sites of turtles. The death of gravid female turtles like the present one decreases the fecundity of the species population to a considerable extent, as this type of accident may occur frequently.

Awareness among local fishermen community as well as proper implementation of existing laws and regular surveillance by the concerned government authorities are necessary to save this vulnerable species from the threat of extinction.

REFERENCES

Abreu-Grobois, A. & P. Plotkin (2008): *Lepidochelys olivacea* - The IUCN Red List of Threatened Species 2008. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T11534A3292503.en.

Andrews, H.V., S. Krishnan & P. Biswas (2006): Distribution and status of marine turtles in the Andaman and Nicobar Islands. Pp. 33–57. *In*: Marine Turtles of the Indian Subcontinent (Eds: Shanker, K. & B.C. Choudhury). Universities Press, Hyderabad. India.

Asrar, F.F. (1999): Decline of marine turtle nesting populations in Pakistan. *Marine Turtle Newsletter 83*: 13–14.

BBC (2016): Endangered Olive Ridley turtles found dead on India coast. http://www.bbc.com/news/world-asia-india-35369073. Uploaded on January 21, 2016. http://www.seaturtle.org

Bhupathy, S. & S. Saravanan (2002): Status Survey of Sea Turtles along the Tamil Nadu Coast. *Kachhapa 7*: 7–13.

Giri, V. & N. Chaturvedi (2003): Status of marine turtles in Maharashtra, India. *Kachhapa 8*: 11–15.

Hazel, J. & E. Gyuris (2006): Vessel-related mortality of sea turtles in Queensland, Australia. *Wild. Res. 33*: 149–154.

Hazel, J., I.R. Lawler, H. Marsh & S. Robson (2007): Vessel speed increases collision risk for the green turtle *Chelonia mydas*. *Endan. Sp. Res. 3*: 105–113.

Kar, C.S. & S. Bhaskar (1982): The status of Sea Turtles in the Eastern Indian Ocean. Pp. 365–372. *In*: K. Bjorndal (Ed.): The Biology and Conservation of Sea Turtles (repr. 1995). Smithsonian Institution Press, Washington D.C.

Kar, C.S. & M.C. Dash (1984): Conservation and Status of Sea Turtles in Orissa. *In*: Silas, E.G. (Ed.): Proceedings of the Workshop on Sea Turtle Conservation. CMFRI Special Publication 18: 93–107.

Kar, C.S. (2001): Review of Threats to Sea Turtles in Orissa. Pp. 15–19. *In*: Shanker, K. and B.C. Choudhury (Eds): Proceedings of the National Workshop for the Development of a National Sea Turtle Conservation Action Plan, Bhubaneswar, Orissa, India: Wildlife Institute of India, Dehradun.

Limpus, C.J. (1995): Global overview of the status of marine turtles: a 1995 viewpoint. Pp. 605–609. *In*: Bjorndal K.A. (Ed.): Biology and Conservation of Sea Turtles: Revised Edition. Smithsonian Institution Press, Washington D.C.

Márquez, M.R. & H.G. Van Dissel (1982): A method for evaluating the number of massed nesting Olive Ridley sea turtles, *Lepidochelys olivacea*, during arribazón behaviour. *Nether. J. Zool. 32(3)*: 419-425.

Pandav, B., B.C. Choudhury & C.S. Kar (2006): Sea turtle nesting habitats on the coast of Odisha. Pp. 88–106. *In*: Marine Turtles of the Indian Subcontinent (Eds: Shanker, K. & B.C. Choudhury). Universities Press (India) Pvt. Ltd.

Rajagopalan, M., E. Vivekanandam, S.K. Pillai, M. Srinath & B.A. Fernando (1996): Incidental catch of sea turtles in India. *Marine Fisheries Information Service 143*: 8–13.

Raut, S.K. & N.C. Nandi (1986): Net-bound death of Olive Ridley Turtle *Lepidochelys olivacea*. *J. Bombay Nat. Hist. Soc. 83(1)*: 223–224.

Roychoudhury, B. (2001): A short survey on sea turtles in West Bengal. A Government of India/UNDP sea turtle project report. Nature, Environment and Wildlife Society, Calcutta.

Shanker, A. & R. Kutty (2005): Sailing the flagships fantastic: Different approaches to Sea Turtle conservation in India. *Mast 3(2) & 4(1)*: 213–240.

Sridhar, A. (2005): Sea turtle conservation and fisheries in Orissa, India. International Collective in Suppport of Fishworks. Chennai, India. Samudra Monograph.

Subrata, K.B., C.S. Kar, B. Satyaranjan, J. Sajan, K. Sivakumar & B.C. Choudhury (2013): Abundance of Olive Ridleys along Odisha coast: sources of mortality and relative importance of fisheries impacts. Pp. 311–321. *In*: Venkataraman K., C. Sivaperuman, and C. Raghunathan (Eds): Ecology and Conservation of Tropical Marine Faunal Communities. Springer-Verlag, Berlin & Heidelberg.

Thorbjarnarson, J.B., S.G. Platt & S.T. Khaing (2000): Sea turtles in Myanmar: past and present. *Marine Turtle Newsletter 88*: 10–11.

Tripathi, B., R.S. Kumar, B.C. Choudhury, K. Sivakumar & A.K. Nayak (2008): Compilation of Research Information on Biological and Behavioural Aspects of Olive Ridley Turtles along the Odisha coast of India – A Bibliographical Review for Identifying Gap Areas of Research. Wildlife Institute of India, Dehradun.

Wright, B. & B. Mohanty (2006): Operation Kachhapa: An NGO initiative for sea turtle conservation in Orissa. Pp. 290–302. *In*: Marine Turtles of the Indian Subcontinent (Eds: Shanker, K. and B.C. Choudhury), Universities Press, Hyderabad, India.

Recommended Citation

Das, Dipanwita and Sudipta Mandal (2019): Unusual death of an Olive Ridley Sea Turtle in Dhabaleswar sea beach, Odisha, India. *J. Bombay Nat. Hist. Soc. 116*: 111–114. doi: 10.17087/jbnhs/2019/v116/101275

21. CONGREGATION OF AN ENDEMIC SNAKE *RHABDOPS OLIVACEUS* (BEDDOME, 1863) IN NORTHERN WESTERN GHATS, MAHARASHTRA[1]

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[1]Accepted July 07, 2017
First published: February 28, 2019 | doi: 10.17087/jbnhs/2019/v116/109400
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The genus *Rhabdops* (Boulenger, 1893) is represented by two species in India, namely, *Rhabdops bicolor* (Blyth, 1854) which is distributed in north-east India and *Rhabdops olivaceus* (Beddome, 1863) which was originally described as *Ablabes olivaceus* on the basis of specimens collected from Mananthavady, Wayanad district in Kerala state. Boulenger (1893) formed a new genus *Rhabdops* on the basis of dentition and head characters, and shifted the species under it as *Rhabdops olivaceus.*

Olive Trapezoid Snake *Rhabdops olivaceus* is an endemic snake from India (Ganesh *et al.* 2012), distributed in the Western Ghats from Manantoddy, Wyanad (now Wayanad) to Kaas plateau, Satara (Boulenger 1890, 1893; Chikane and Bhosale 2012). It has been reported from four Indian states, namely, Goa, Karnataka, Kerala, and Maharashtra (Khaire 2006; Radhakrishnan 1997) It is considered to be nocturnal (Whitaker and Captain 2004) but has also been reported to be active by day (Ganesh *et al.* 2012). *R. olivaceus* is terrestrial, mainly found along primary streams in crestline forests. It feeds mainly on earthworm and slugs. During daytime, it hides under logs, rocks, and similar places (Khaire 2014).

On September 28, 2014, during a field visit to Koyna Wildlife Sanctuary (17° 46′ 49.35″ N, 73° 41′ 59.9532″E), I encountered an unusual congregation of *Rhabdops olivaceus* (n=17) at 22:30 hrs. The individuals ranged from subadults to adults (±345–560 mm). The microhabitat, a hill stream, was in an evergreen forest. All specimens were found in the seasonal stream. The specimens were under a rock, submerged by shallow water.

The snakes were identified by comparing scalation data with Smith (1943). A total of 17 specimens were measured and released immediately. The reason behind this gathering could not be ascertained. Such a congregation of *Rhabdops olivaceus*, a Western Ghats endemic whose ecology is largely unknown, has never been reported. Hence, this behaviour is noteworthy.

ACKNOWLEDGEMENTS

I thank Anilkumar Khaire, Bapurao Jadhav, Varad Giri, Deepak Sawant, Aniruddha Joshi, Aditya Mardikar, Shweta Singh, and Priya Warekar for their help in my field visit and Ashok Captain (Indian Herpetological Society, Pune) for reviewing the draft.

REFERENCES

BEDDOME, R.H. (1863): Further notes upon snakes of Madras Presidency; with descriptions of two new species. *Madras Quart. J. Med. Sci. 6*: 41–48.

BLYTH, E. (1854): Notices and descriptions of various reptiles, new or little known (Part-2). *Journal of the Asiatic Society of Bengal 23(3)*: 287–302.

BOULENGER, G.A. (1890): The Fauna of British India including Ceylon and Burma. Reptilia and Batrachia. Taylor & Francis, London.

BOULENGER, G.A. (1893): Catalogue of the Snakes in the British Museum (Natural History). Vol. 1. Taylor & Francis, London.

CHIKANE, S. & H. BHOSALE (2012): Reptiles of Kaas, Northern Western Ghats, Maharashtra, India, with notes on habitat preferences, abundances and threats. *Sauria Berlin 34(3)*: 3–15.

GANESH, S.R., S.R. CHANDRAMOULI & P.G. SHANKAR (2012): Record lengths of two endemic caenophidian snakes from the Western Ghats Mountains, India. *Hamadryad 36(1)*: 44–46.

KHAIRE, N. (2006): A Guide to the Snakes of Maharashtra, Goa & Karnataka. Indian Herpetological Society, Pune.

KHAIRE, N. (2014): Indian Snakes – a Field Guide. Jyotsna Prakashan, Pune. Pp. 74–75.

RADHAKRISHNAN, C. (1997): Notes on a new distributional record and the ecology of *Rhabdops olivaceus* (Beddome) (Reptilia, Serpentes, Colubridae). *J. Bombay Nat. Hist. Soc. 94(1)*: 167–168.

SMITH, M.A. (1943): The Fauna of British India, Ceylon and Burma including the whole of the Indo-Chinese Sub-region. Reptilia and Amphibia. Vol. 3 Serpentes. Taylor & Francis, London.

WHITAKER, R. & A. CAPTAIN (2004): Snakes of India – The Field Guide. Draco Books, Chennai. Pp. 264–267.

Recommended Citation

Ashaharraza, K. (2019): Congregation of an endemic snake *Rhabdops olivaceus* (Beddome, 1863) in northern Western Ghats, Maharashtra. *J. Bombay Nat. Hist. Soc. 116*: 115. doi: 10.17087/jbnhs/2019/v116/109400

22. STRIKING COLOUR CHANGE PATTERN AGAINST HETEROGENEOUS BACKGROUNDS IN ASIAN PAINTED FROG *KALOULA PULCHRA*[1]

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[1]Accepted December 13, 2018
First published: April 30, 2019 | doi: 10.17087/jbnhs/2019/v116/121380
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Asian Painted Frog *Kaloula pulchra* is a species commensal with humans, and rapidly colonizes urban habitats. It is quite adaptable and was presumably originally a wetland edge species that has adapted successfully to agricultural and residential landscapes (Kuangyang *et al.* 2004). Observations were made in the Central University of Tamil Nadu (CUTN), Thiruvarur campus, which is located in a riverine wetland in Cauvery river basin. This habitat is characterized by clay soil, and has varied microhabitats such as small ponds, woodlands, shrub land, and grasslands.

A juvenile Asian Painted Frog *Kaloula pulchra* accidentally entered my lavatory on December 08, 2017. At the time of entry it had dark brown spots throughout the dorsal side of its body (Fig. 1a). The frog became an inhabitant in my lavatory. The lavatory is well-equipped with bright coloured tiles and lights. About a month later, the frog had grown to medium size and a striking colour change was observed, as its dorsal dark brown spots turned light brown, and its fore and hind limbs became transparent (Fig. 1b).

Physiologically, colour change in frogs occurs due to the synchronous movements of pigment organelles within chromatophores, which are chiefly regulated by hormones (Nilsson Skold *et al.* 2013). External environmental factors that influence colour change in frogs include light intensity, background colour, and temperature. Several previous studies have concluded that frogs become light pigmented under brighter illumination and higher temperature. The evolution of colour changing ability is thought to be primarily driven by camouflage through background colour matching (Kang *et al.* 2016). The mechanism by which animals change their colour and patterns against visually heterogeneous backgrounds has been identified in frogs. Kang *et al.* (2016) have concluded that frogs primarily respond to the achromatic differences in background, their contrasting dorsal colour patterns are conditionally expressed depending on the brightness of the background. Moreover, they report that against mixed coloured background, frogs adapt into intermediate forms between the two colours. The colour change observed in this case in Asian Painted Frog *Kaloula pulchra* might also have occurred due to the heterogeneous background in its habitat.

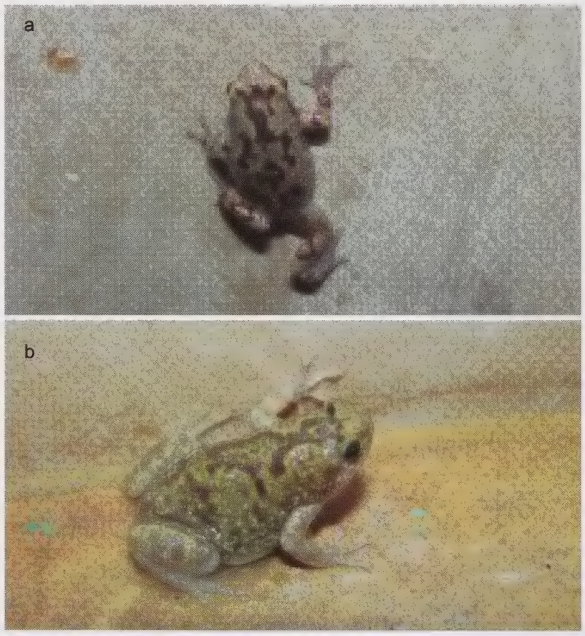

Fig 1: Asian Painted Frog *Kaloula pulchra*
a) juvenile, b) The same specimen after 22 days

REFERENCES

Kuangyang, L., Y. Zhigang, S. Haitao, G. Baorong, P.P. van Dijk, D. Iskandar, R.F. Inger, S. Dutta, S. Sengupta, S. Uddin Sarker & G. Asmat (2004): *Kaloula pulchra* (errata version published in 2016). The IUCN Red List of Threatened Species 2004: e.T57855A86163405. Downloaded on March 28, 2019.

Kang, C., Ye Eun Kim & Jang Yikweon (2016): Colour and pattern change against visually heterogeneous backgrounds in the tree frog *Hyla japonica*. *Sci. Rep. 6*: 22601.

Nilsson Skold, H., S. Aspengren & M. Wallin (2013): Rapid colour change in fish and amphibians – function, regulation, and emerging applications. *Pigment Cell Melanoma Res. 26(1)*: 29–38.

Recommended Citation

Alexandar, R. (2019): Striking colour change pattern against heterogeneous backgrounds in Asian Painted Frog *Kaloula pulchra*. *J. Bombay Nat. Hist. Soc. 116*: 116. doi: 10.17087/jbnhs/2019/v116/121380

23. *MINERVARYA* SP. (AMPHIBIA: FAMILY DICROGLOSSIDAE) TADPOLES FEEDING ON A DEAD TOAD[1]

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[1]Accepted August 08, 2019
First published: December 31, 2019 | doi: 10.17087/jbnhs/2019/v116/144439
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At around 15:00 hrs on June 30, 2018, *Minervarya* sp. tadpoles were observed feeding on the carcass of a toad *Duttaphrynus* sp. in a man-made water tank at Amboli (15.960676° N, 73.998132° E, elevation 690 m above msl), Sindhudurg district, Maharashtra, India.

The tadpoles were identified as *Minervarya* sp. from photographs taken at the site, based on expert opinion (Prudhvi Raj *pers. comm*. January 2019).

The tadpoles were observed actively nibbling on the ventral and lateral portions of the toad, presumably avoiding the harder dorsal region (Fig. 1). While there were many tadpoles present in the tank, only a few individuals were noticed feeding on the carcass at a time. This scavenging behaviour was observed for about one hour, until a major portion of the carcass was eaten.

Fig. 1: *Minervarya* sp. tadpoles feeding on toad of Bufonidae family

Adapted for filter-feeding, the majority of anuran tadpoles are herbivorous. However, carnivorous behaviour has been observed in some species (Polis and Myers 1985; Saidapur 2001; Sekar 1992).

Bragg (1940) observed that tadpoles of *Bufo cognatus* were partly scavengers, feeding on insect remains and other animal matter softened by water or bacteria. Tadpoles of genus *Hoplobatrachus* have been recorded exhibiting carnivorous (Grosjean *et al*. 2004) and cannibalistic (Rajput *et al*. 2011) behaviour. *Euphlyctis cyanophlictis* tadpoles were reported feeding on zooplankton during the later stages of their development (Lalremsanga *et al*. 2013). *Duttaphrynus melanostictus* tadpoles were observed feeding on conspecific eggs, tadpoles, and adult carrion, as well as dead heterospecific tadpoles (Mahapatra *et al*. 2017), and on a dead *Microhyla ornata* (Vyas 2013). In an experiment, tadpoles native to the habitat of *Bufo marinus* consumed its toxic dead tadpoles without suffering any ill-effects, purportedly as a result of resistance developed from evolutionary exposure (Crossland and Azevedo-Ramos 1999).

The observations during the present study are considered to be the first documentation of *Minervarya* sp. tadpoles scavenging on a dead adult toad in the wild.

According to Singh *et al*. (2014), tadpoles are opportunistic omnivores or detritivores that need to consume food that will ensure their metamorphosis prior to the drying up of their pond. Since there appeared to be other food such as moss and floating vegetation in the tank, we believe that the toad carcass presented an opportunistic food source for the tadpoles.

ACKNOWLEDGEMENTS

We thank Prudhvi Raj, Wildlife Institute of India, for help with the identification of the tadpoles. We also thank Dr Varad Giri for constant guidance and support.

REFERENCES

BRAGG, A.N. (1940): Observations on the ecology and natural history of Anura. I. Habits, habitat and breeding of *Bufo cognatus* Say. *The American Naturalist 74(754)*: 424–438. https://www.journals.uchicago.edu/doi/abs/10.1086/280911

CROSSLAND, M.R. & C. AZEVEDO-RAMOS (1999): Effects of *Bufo* (Anura: Bufonidae) toxins on tadpoles from native and exotic *Bufo* habitats. *Herpetologica 55*: 192–199. https://www.jstor.org/stable/3893079?seq=1#page_scan_tab_contents

GROSJEAN, S., M. VENCES & A. DUBOIS (2004): Evolutionary significance of oral morphology in the carnivorous tadpoles of tiger frogs, genus *Hoplobatrachus* (Ranidae). *Biological Journal of the Linnean Society 81*: 171–181. https://www.researchgate.net/publication/227636045_Evolutionary_significance_of_oral_morphology_in_the_carnivorous_tadpoles_of_tiger_frogs_genus_Hoplobatrachus_Ranidae_EVOLUTION_OF_CARNIVOROUS_TADPOLES

LALREMSANGA, H.T., R.N.K. HOOROO & S. LALRONUNGA (2013): Oral morphology and feeding behaviour of *Euphlyctis cyanophlyctis* tadpoles (Schneider, 1799) with notes on feeding behaviour. *Science and Technology Journal 1(2)*: 58–69. https://www.researchgate.net/publication/259438861_Oral_morphology_of_the_tadpoles_of_Euphlyctis_cyanophlyctis_Schneider_1799_with_notes_on_feeding_behaviour

MAHAPATRA, S., G. SAHOO & S.K. DUTTA (2017): Opportunistic predatory behaviour in *Duttaphrynus melanostictus* (Schneider, 1799) tadpoles. *Current Science 112(8)*: 1755–1759. https://www.currentscience.ac.in/Volumes/112/08/1755.pdf

POLIS, G.A. & C.A. MYERS (1985): A survey of intraspecific predation among reptiles and amphibians. *Journal of Herpetology 19*: 99–107. https://www.jstor.org/stable/1564425?seq=1#page_scan_tab_contents

RAJPUT, A.P., B.A. SHANBHAG & S.K. SAIDAPUR (2011): Absence of kin discrimination in cannibalistic anuran tadpoles of the frog *Hoplobatrachus tigerinus* (Daudin). *Indian Journal of Experimental Biology 49*: 362–365. http://nopr.niscair.res.in/handle/123456789/11635

SAIDAPUR, S.K. (2001): Behavioral ecology of anuran tadpoles: the Indian scenario. *Proceedings of Indian National Science Academy B67*: 311–322. http://repository.ias.ac.in/88216/1/88216.pdf

SEKAR, A.G. (1992): A study of the food habits of six anuran tadpoles. *J. Bombay Nat. Hist. Soc. 89(1)*: 9–16. https://www.biodiversitylibrary.org/page/48732498#page/21/mode/1up

SINGH, P., M. DEY & S.N. RAMNUJAM (2014): Assessing feeding habits of tadpoles of *Leptobrachium smithi* (Matsui *et al.* 1999) during different development stages: a qualitative and quantitative study from Rosekandy Tea Estate, Cachar, Assam. *International Journal of Scientific and Research Publications 4(5)*: 1–6. http://www.ijsrp.org/research-paper-0514/ijsrp-p2980.pdf

VYAS, R. (2013): Note on the tadpole of Indian bullfrog *Hoplobatrachus tigerinus* scavenging on ornate narrow-mouthed frog *Microhyla ornata*. *Frogleg 19*: 3–4. https://www.zoosprint.zooreach.org/ZoosPrintNewsLetter/Frog%20leg_19_2013.pdf

Recommended Citation

Gazdar, Roozbeh, Krishnendu Banerjee and Golda T. D'costa (2019): *Minervarya* sp. (Amphibia: Family Dicroglossidae) tadpoles feeding on a dead toad. *J. Bombay Nat. Hist. Soc. 116*: 117–118. doi: 10.17087/jbnhs/2019/v116/144439

24. A PRELIMINARY SURVEY OF AMPHIBIA IN MEHAO WILDLIFE SANCTUARY, ARUNACHAL PRADESH, INDIA[1]

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[1]Accepted December 20, 2018
First published: July 31, 2019 | doi: 10.17087/jbnhs/2019/v116/129177
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Introduction

Arunachal Pradesh is the easternmost state of India, surrounded by China on the north, Bhutan to the west, Myanmar to the east, and Assam and Nagaland on the southern limits, within coordinates 26.28°–29.30° N and 91.20°–97.30° E, with an area of 83,743 sq. km. The entire state comprises a complex hill system with varying elevations ranging from the plains of Brahmaputra (average elevation 100 m above msl) reaching an elevation of 7,089 m, representing all the three Himalayan zones. An important part of the Eastern Himalaya biodiversity hotspot, Arunachal Pradesh has diverse geographical landscapes ranging from snow-capped mountains to dense tropical rainforest and foothills, hill streams and rivers dissecting the topography. The unique topography, varied physiographical features and watershed patterns, with varied climatic conditions, harbour myriad flora and fauna.

Situated roughly between 28° 5′–28° 15′ N and 93° 30′–95° 45′ E, with altitudes ranging from 400 m to 3,568 m above msl, Mehao Wildlife Sanctuary in Lower Dibang Valley district of Arunachal Pradesh is still among the least explored areas in the country. As part of the faunal documentation of Mehao WLS, opportunistic collection of amphibians was done, and taxonomic studies on the collected specimens constitute this preliminary report.

Regarding this subject, contributions on the amphibians of Arunachal Pradesh have been greatly enriched by the works of Annandale (1912), Sarkar and Sanyal (1985), Chanda (1994, 2002), Bordoloi *et al.* (2000), Sarkar and Ray (2006), Mathew and Sen (2009, 2010), Bordoloi and Borah (2009),

Tesia and Bordoloi (2013), Kamei *et al.* (2013), Mahony *et al.* (2013), Saikia *et al.* (2017), and Ohler *et al.* (2018).

Material and methods

Five field surveys of 10–15 days duration were undertaken in Mehao WLS from April 2015 to January 2017, covering all the seasons. Standard methodologies were employed for collection and preservation of amphibian specimens (Ravichandran 2004). Frost (2018) was followed for classification. All the specimens have been collected by the third author, Dr S.D. Gurumayum, and deposited in Arunachal Pradesh Regional Centre, Zoological Survey of India, Itanagar.

Taxonomic account

Phylum: Vertebrata
Class: Amphibia
Order: Anura

Family: Bufonidae

1. ***Duttaphrynus melanostictus* (Schneider, 1799)**: A relatively common toad in this part of India, characterized by the presence of a pair of big parotid glands, dark cranial ridge, and rough dorsal skin. As per IUCN (2016), it is a Least Concern species due to its abundant population and wide distribution. Four specimens were collected from two locations.

Material Examined: 3 specimens: Voucher no.: ZSI/APRC/A-108, Asopani river footpath, Roing, 05.v.2015; 1 specimen: ZSI/APRC/A-239, small drain 2 km from Nizamghat, 24.i.2017.

Family: Dicroglossidae

2. ***Euphlyctis cyanophlyctis* (Schneider, 1799)**: Another common anuran, this frog is commonly found in ponds, pools, marshes, paddy fields, and any aquatic habitat. Probably the most common and abundant frog in the whole of South Asia, this frog is catalogued as Least Concern by IUCN (2009). Four specimens were collected from two locations.

Material Examined: 1 specimen: Voucher no.: ZSI/APRC/A-129, Sally Lake, 15.x.2015; 3 specimens: ZSI/APRC/A-236, small drain between Ingino and Coronu river, 22.i.2017.

3. ***Minervarya nepalensis* (Dubois, 1975)**: Small frog commonly found in and around brooks, paddy fields, and other aquatic and semi-aquatic habitats. This is another Least Concern species as per IUCN (2016). Two specimens were collected from the same location during two different surveys.

Material Examined: 1 specimen: Voucher no.: ZSI/APRC/A-128, Sally Lake, 15.x.2015; 1 specimen: Voucher no.: ZSI/APRC/A-127, Sally Lake, 31.iii.2016.

4. ***Minervarya pierrei* (Dubois, 1975)**: Known as Pierre's Wart Frog, it is also associated with paddy fields and aquatic habitats. Characterized by long and prominent longitudinal folds over its dorsum, and strikingly pointed head. Due to its wide distribution, it is a Least Concern species as per IUCN (2016). Four specimens were collected from two locations on three occasions.

Material Examined: 2 specimens: Voucher no.: ZSI/APRC/A-234, Sally Lake, 18.i.2017 and 2 specimens: Voucher nos.: ZSI/APRC/A-238 & 243, small drain 2 km from Nizamghat, 22.i.2017 and 26.i.2017.

5. ***Minervarya syhadrensis* (Annandale, 1919)**: The smallest among cricket frogs of north-east India, this species is abundant in habitats similar to its congeners mentioned above. It is a Least Concern species as per IUCN (2016). Five specimens were collected from two localities.

Material Examined: 1 specimen: ZSI/APRC/A-107, near Roing forest IB, 1.v.2015; 1 specimen: ZSI/APRC/A-237, 22.i.2017, and 3 specimens: ZSI/APRC/A-242, all from small drain 2 km from Nizamghat, 26.i.2017.

6. ***Limnonectes khasianus* (Anderson, 1871)**: Previously limited to Meghalaya; however, after *Limnonectes laticeps* became a junior synonym of *L. khasianus* (Ohler and Deuti 2013), the previous distribution range of *L. laticeps* gives *L. khasianus* a wider distributional geographical range.

Material Examined: 1 specimen: Voucher no.: ZSI/APRC/A-244, small drain 2 km from Nizamghat, 26.i.2017.

7. ***Nanorana* cf. *annandalii* (Boulenger, 1920)**: A single specimen (ZSI/APRC/A-233) of this species was collected from Mayodia on September 02, 2016, but badly preserved, due to which it could not be identified with precision; hence, it is conferred to this species. Although *N. annandalii* was previously reported from Tawang in western Arunachal Pradesh (Bordoloi *et al.* 2001), this is the first report of the species from eastern Arunachal Pradesh. As per IUCN (2008), it is Near Threatened.

Family: Ranidae

8. ***Amolops formosus* (Gunther, 1876)**: Commonly inhabits cascades, waterfalls, and rocky rivers. Although its population is showing a declining trend, as per IUCN (2004), it is regarded as Least Concern due to its wide geographical distribution.

Material Examined: 1 specimen: Voucher no.: ZSI/APRC/A-245, Mehao foothills, 27.i.2017.

9. ***Amolops gerbillus*** **(Annandale, 1912)**: Commonly found in streams, brooks, etc. The collection locality was adjacent to the type locality Siang Valley (=Abor Hills) at Yembung, on the way to Pangin. Five specimens were collected from two localities. It is a Least Concern species as per IUCN (2004).

Material Examined: 1 specimen: Voucher no.: ZSI/APRC/A-240, Simari river bank, 24.i.2017; 4 specimens: Voucher no.: ZSI/APRC/A-241, small drain 2 km before Nizamghat, 26.i.2017.

10. ***Amolops monticola*** **(Anderson, 1877)**: Not common, although it has a wide range of occurrence. Previously reported from Arunachal Pradesh by Borah and Bordoloi (2003). Found in rapids, preferably in shaded areas, and other fast streams and waterbodies. As per IUCN (2004), it is a Least Concern species.

Material Examined: Four specimens, Voucher no.: ZSI/APRC/A-246, Theta river bank, Roing, 18.i.2017.

Family: Rhacophoridae

11. ***Polypedates assamensis*** **Mathew & Sen (2009)**: A recently described frog from Assam, type locality adjacent to the borders of Arunachal Pradesh.Since its description, Saikia (2012) has reported its occurrence from Meghalaya.

Material Examined: 1 specimen, Voucher no.: ZSI/APRC/A-106, surrounds of Roing, 01.i.2015, which was the basis for the publication of a new distribution record from the state (Saikia *et al*. 2017).

12. ***Theloderma asperum*** **(Boulenger, 1886)**: This warty tree frog is rarely observed in the wild, maybe due to its cryptic habit. Spends most of its life in tree cavities filled with water. It is regarded as a Least Concern species by IUCN (2004).

Material examined: 1 specimen, Voucher no.: ZSI/APRC/A-135, Asopani footpath, 3.iv.2016.

13. ***Theloderma moloch*** **(Annandale, 1912):** Another species of frog whose type locality is the nearby Siang Valley (Abor Hills), Upper Renging, near Pasighat. Although no specimen was collected, we are including this species based on the report of its occurrence in Mehao (Roy *et al.* 2017). It is Vulnerable, as per IUCN (2004).

Discussion

Although this is a preliminary report, and nowhere complete, nevertheless it is the first amphibian inventory of Mehao Wildlife Sanctuary and its environs. During five surveys undertaken at Mehao WLS from March 2015 to January 2017, in which 51 specimens of amphibians were collected, 12 species under 8 genera, 4 families and 1 order were found. Additionally, one more rhacophorid frog *Theloderma moloch* is included in the list based on a published record (Roy *et al*. 2017). A rare frog *Amolops monticola* is also reported, while the conferred *Nanorana annandalei* is the first report from eastern Arunachal Pradesh. Representatives of Orders Gymnophiona and Caudata were not recorded during the present investigation.

ACKNOWLEDGEMENTS

The authors are thankful to the Director, Zoological Survey of India, Kolkata and Officer-in-Charge, Arunachal Pradesh Regional Centre, ZSI for their support.

REFERENCES

Annandale, N. (1912): Zoological Results of the Abor Expedition, 1911–1912, Batrachia. *Rec. Indian Mus. 8*: 7–36.

Borah, M.M. & S. Bordoloi (2003): Altitudinal distribution pattern of Amphibian fauna of Arunachal Pradesh with special reference to Dehang-Debang Biosphere Reserve, Arunachal Pradesh, India. *Himalayan Biosphere Reserve Bulletin 5(1–2)*: 51–55.

Bordoloi, S. & M.M. Borah (2009): Diversity and ecology of amphibian fauna in the wetlands of Arunachal Pradesh, India in the wetlands of NE India. Ed. Laishram Kosygin. Akansha Publishing House, New Delhi. 343 pp.

Bordoloi, S., M.M. Borah, K. Sharma & S.N. Kalita (2000): An overview of amphibian fauna of Arunachal Pradesh. *J. Assam Sci. Soc. 41(4)*: 363–371.

Bordoloi, S., M.M. Borah, P. Chakravorty & B. Sinha (2001): First record of the Ranid frog *Paa annandalii* (Boulenger, 1920) from north-eastern region (Arunachal Pradesh) of India with a note on its larval stages. *Current Science 80(9)*: 1219–1222.

Chanda, S.K. (1994): Anuran (Amphibia) fauna of Northeast India. *Mem. Zool. Surv. India 18*: 1–143.

Chanda, S.K. (2002): Handbook of Indian Amphibians. Published by the Director, Zoological Survey of India, Kolkata. i–viii, 335 pp.

Frost, D.R. (2018): Amphibian Species of the World: an Online Reference. Version 6.0. Accessed on December 12, 2018. Electronic Database accessible at http://research.amnh.org/herpetology/amphibia/index.html. American Museum of Natural History, New York, USA.

Kamei, R.G., D.J. Gower, M. Wilkinson & S.D. Biju (2013): Systematics of the caecilian family Chikilidae (Amphibia: Gymnophiona) with the description of three new species of *Chikila* from northeast India. *Zootaxa 3666 (4)*: 401–435.

Mahony, S., E.C. Teeling & S.D. Biju (2013): Three new species of horned frogs *Megophrys* (Amphibia: Megophryidae) from northeast India, with a resolution to the identity of *Megophrys boettgeri* populations reported from the region. *Zootaxa 3722(2)*: 143–169.

Mathew, R. & N. Sen (2009): Studies on little known amphibians of Northeast India. *Records of the Zoological Survey of India. Occasional Papers 293*: 1–64, 23 pls. Published by the Director, Zoological Survey of India, Kolkata.

Mathew, R. & N. Sen (2010): Pictorial Guide to Amphibians of North East India. Published by the Director, Zoological Survey of India, Kolkata. 144 pp.

Ohler, A. & K. Deuti (2013): *Pyxicephalus khasianus* Anderson, 1871 and *Rana laticeps* Boulenger, 1882 (Dicroglossidae, Anura, Amphibia) are synonyms. *Zoosystema 35(3)*: 415–424.

Ohler, A., M.M. Borah, M.K. Das, C. Tesia & S. Bordoloi (2018): A study on amphibian fauna of Arunachal Pradesh (India). *Alytes 36(1–4)*: 276–288.

Ravichandran, M.S. (2004): Amphibia. Pp. 237–241. *In*: Collection, Preservation and Identification of Animals (Eds: J.R.B. Alfred and Ramakrishna). Zoological Survey of India, Kolkata.

Roy, J.K., R.H. Begum & M.F. Ahmed (2017): Report on poorly known *Theloderma moloch* (Annandale, 1912) from Arunachal Pradesh, Northeast India. *Russian Journal of Herpetology 24(3)*: 248–250.

Saikia, B. (2012): Occurrence of *Amolops assamensis* Sengupta *et al.* 2008 (Amphibia: Anura: Ranidae) and *Polypedates assamensis* Mathew and Sen, 2009 (Amphibia: Anura: Rhacophoridae) in Meghalaya. *Rec. Zool. Surv. India 112(4)*: 127–128.

Saikia, B., M. Devanda, S.D. Gurumayum, I.J. Kharkongor & B. Sinha (2017): Addition to the amphibia fauna of Arunachal Pradesh, India. *Rec. Zool. Surv. India 117(2)*: 118–121.

Sarkar, A.K. & D.P. Sanyal (1985): Namdapha Biosphere Reserve: An overview: Amphibia. *Rec. zool. Surv. India 82(1–4)*: 185–295.

Sarkar, A.K. & S. Ray (2006): Amphibia. *In*: Fauna of Arunachal Pradesh, State Fauna Series *13(1)*: 285–316. Published by Zoological Survey of India, Kolkata.

Tesia, C. & S. Bordoloi (2013): Report on Amphibian Fauna of Khonsa Circle, Tirap District, Arunachal Pradesh, India. *Global J. of Bioscience and Biotechnology 2(4)*: 493–495.

Recommended Citation

Saikia, Bhaskar, Mahendra Devanda, and S.D. Gurumayum (2019): A preliminary survey of amphibia in Mehao Wildlife Sanctuary, Arunachal Pradesh, India. *J. Bombay Nat. Hist. Soc. 116*: 118–121. doi: 10.17087/jbnhs/2019/v116/129177

25. ON THE OCCURENCE OF MASKED TRIGGERFISH *SUFFLAMEN FRAENATUM* (TETRAODONTIFORMES: BALISTIDAE) FROM DIGHA COASTAL WATERS, WEST BENGAL, NORTH-EAST COAST OF INDIA[1]

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[1]Accepted July 18, 2019
First published: December 31, 2019 | doi: 10.17087/jbnhs/2019/v116/108659
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Introduction

Masked triggerfish belongs to the family Balistidae (Triggerfishes), which comprises 12 genera and 42 valid species (Froese and Pauly 2016). Members of this family are associated with a variety of tropical and subtropical marine habitats, such as sandflats or silt beds, coastal hard rocky bottom, and reef associated marine environments at depths ranging from the coastline to *c.* 13–90 m (Kuiter and Tonozuka 2001). Masked triggerfish are usually solitary (Allen and Erdmann 2012), shallow water inhabitants and primarily pelagic in open waters. Triggerfish are also found over sand and rubble patches on seaward facing coral reefs; some species are found even as deep as 200 m. There are numerous reports and studies carried out so far on the ichthyofaunal diversity of northern Bay of Bengal (Chatterjee *et al.* 2000; Das *et al.* 2007; Goswami 1992; Kar *et al.* 2017; Manna and Goswami 1985; Sanyal *et al.* 2012; Talwar *et al.* 1992; Venkataraman *et al.* 2012; Yennawar *et al.* 2017), but genus *Sufflamen* had not been reported from the West Bengal coast. From family Balistidae, only one species *Abalistes stellatus* (Anon. 1798) has been previously reported from the north-eastern coast of India (Yennawar *et al.* 2017). During an institutional survey around Digha coast on August 19, 2016, at 10:00 hrs, we collected a single specimen of triggerfish. Subsequent morphological analysis of the specimen identified it as *Sufflamen fraenatum* (Latreille, 1804). The present record of this balistid fish adds to the list of reef associated fish fauna from the West Bengal coast, showing the need for further study in habitat preference and faunal assemblage of these species.

Material and Methods

The single specimen was obtained from Digha Mohana fish landing centre, caught by a commercial trawler at 15–40 m depth. After collection, photographs were taken in the field and the specimen was preserved in 4% formaldehyde

Table 1: Morphometric measurements of *Sufflamen fraenatum* collected from Digha

Morphometric characters	Measurement
Standard length (mm)	175.1
% of Standard Length	
Head length (HL)	41.8
Head width (HW)	18.9
Body depth (BD)	33.1
Eye diameter (ED)	7.3
Snout length (SnL)	7.0
Pre-orbital length (PoL)	7.8
Pectoral fin length	9.8
Pectoral fin base length	16.0
Anal fin length	11.0
Caudal fin length	7.0
Caudal peduncle length	22.1
Caudal peduncle height	16.3
Pre-dorsal length (PDL)	24.1
Pre-pectoral length (PPL)	15.5
Pre-pelvic length (PVL)	38.4
Pre-anal length (PAL)	52.2
% of Head length	
Eye diameter	17.5
Head depth (HD)	45.3
Interorbital space	18.7
Caudal peduncle length	52.9

solution, deposited in the museum of the ICAR-Central Institute of Fisheries Education, Kolkata Centre, West Bengal, India. Taxonomic identification of the specimen was done following Smith and Heemstra (1986), Matsuura (2001), Froese and Pauly (2016); methodology for measurements and counts follow Hubbs and Lagler (1947). The specimen was radiographed to count branched and unbranched fin rays. All the measurements were made using digital callipers in millimetre scale to the nearest 0.1 mm, and the specimen was photographed using a digital camera. Morphometric measurements of the specimen are given in Table 1.

The taxonomic characters, including meristic counts and global distribution of the species are discussed below.

Masked Triggerfish

***Sufflamen fraenatum* (Latreille, 1804)** (Fig. 1)

Material examined: CIFE/KOL/MW/F0226; SL:175.1 mm; Collection site: Digha Mohana (21° 37.843′ N, 87° 32.827′ E); Coll.: A. Pradhan and B.K. Mahapatra; 19.viii.2016.

Meristic counts: D. III, i, 30; A. i, 26; P. i, 14; C. ii, 10.

Diagnostic characters: Scales above pectoral fin base and just behind gill opening much enlarged, forming a flexible tympanum; scales of posterior body with keels, forming longitudinal ridges which extend from caudal peduncle to below anterior half of soft dorsal fin. Prominent groove on snout before eye. Upper and lower profiles of head not prominently convex. Mouth small and terminal, pointed teeth white, slightly projecting. Three dorsal fin spines, the third small but readily apparent, and the first spine capable of being locked erect by the second. Caudal peduncle compressed.

Description: Body deep, laterally compressed and rhomboidal, covered with large rectilinear scale plates in regular rows. Body depth at dorsal fin origin 1.8 times in SL. Dorsal profile of head straight with prominent chin; head length 2.4 times to SL. Snout length 6.0 times in HL. Eye placed high on head; its diameter 5.7 times that of HL. Pre-dorsal length 4.1 in SL, dorsal fin base 2.4 in SL. A shallow groove in the skin extending anteriorly from anterior border of eye, narrow at anterior, broader at posterior end. Nostrils placed in a circular depression, dome-shaped, anterior nostril has a fleshy cone-like projection from the inside with an

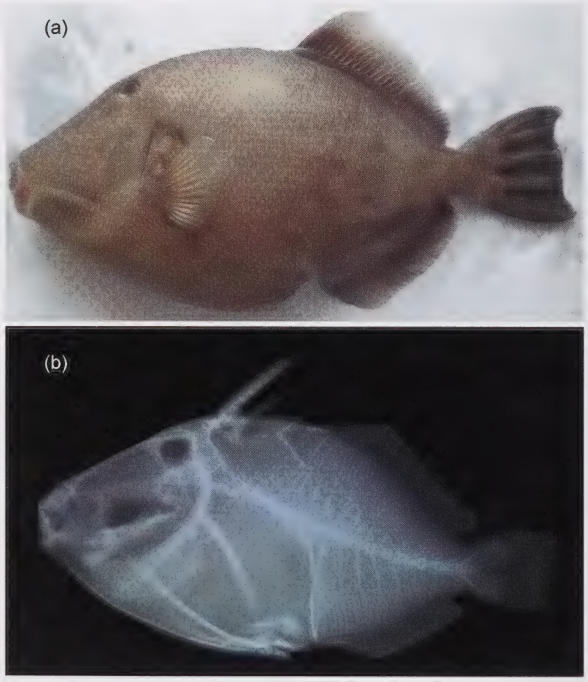

Fig. 1: (a): Preserved specimen; (b): X-ray radiograph of *Sufflamen fraenatum* (SL: 175.1 mm) collected from Digha Mohana fish landing centre, West Bengal: CIFE/KOL/F0226 on 19.viii.2016

Fig. 2: *Sufflamen fraenatum* (CIFE/KOL/F0226):
(a) Dorsal fin; (b) Teeth; (c) Caudal fin (X-ray radiograph)

opening at the tip. Mouth terminal with 2 large strong canine teeth; first tooth of the upper and lower jaw conical with pointed tip, other teeth rectangular with upper side uneven (Fig. 2b). Gill opening short oblique slit in front of pectoral fin base. Gill rakers narrow, 33 in number, on 2nd gill arch. Cheeks with 8 vertical rows of rectangular rudimentary scales; Posterior body scales with keels, forming longitudinal scale ridges which extend from caudal peduncle to below anterior half of soft dorsal fin. Lateral line interrupted with 34 scale plates or shields, reaches the posterior margin of dorsal fin. Two dorsal fins, first dorsal originates behind the vertical of pectoral fin origin, with 3 spines (Fig. 2a), second dorsal with 1 unbranched ray and 30 branched soft rays; first spine stout, laterally compressed, smooth, anteriorly flat, broad and blunt towards tip; third one small, readily apparent. Anal fin with 1 unbranched ray and 26 branched soft rays; pectoral fin round, with 1 unbranched ray and 14 branched rays, and its length 10.2 times to the SL; pelvic fins rudimentary, represented by a series of enlarged scales encasing end of pelvis. Caudal fin truncate with 2 unbranched rays and 10 branched rays (Fig. 2c); caudal peduncle deep, compressed and long; 4.5 in SL.

Colouration (preserved specimen): Body brown and abdomen yellow in colour; presence of two white bands: one prominent white stripe encircling lower jaw and meeting just behind the mouth, another white band present diagonally on the cheek originating from edge of mouth extending to base of pectoral fin. Grey band above upper lip; upper lip band and lower lip band together forming a complete circle in the mouth region. First dorsal fin black. Both second dorsal fin and anal fin black at base and transparent at outer margin of fin. Pectoral fin yellowish-white. Caudal fin dark brown to blackish.

Distribution: The species is widely distributed in the Indo-Pacific region (Smith and Heemstra 1986) from East Africa, through Micronesia to the Pitcairn Islands and Hawaii. The northern and southern limits of this species are Japan and Lord Howe Island (Matsuura and Fricke 2010). From Indian waters, it has been reported from the east coast of India, Tamil Nadu (Sahayak *et al.* 2015); west coast of India, Karnataka (Thomas *et al.* 2011), Kerala (George *et al.* 1976; Sahayak *et al.* 2015); Indian Union Territories, Pondicherry (Mishra and Krishnan 2003), Andaman and Nicobar Islands (Rajan *et al.* 2011; Rao 2010), and Lakshadweep Island (Vijay Anand and Pillai 2002).

Remarks: The genus *Sufflamen* is known to have about five species worldwide (Froese and Pauly 2016). The majority of these species have a dome-shaped anterior nasal aperture with circular or tube-like opening. Scales on cheek rectangular or square or rhomboid with round protuberances; uniform body colouration, while others have distinct dark saddles. The characteristic of horse bridle-like band around mouth and cheek, which extends till base of pectoral fin of *Sufflamen fraenatum* separates it from other triggerfishes (Sahayak *et al.* 2015).

From the year 1985 to 2017, all the checklists published recorded only one species of balistid fish, *Abalistes stellatus* (Anon. 1798), as occurring from West Bengal coast (Kar *et al.* 2017; Manna and Goswami 1985; Yennawar *et al.* 2017). The present study provides the first record of *Sufflamen fraenatum* from the coast of West Bengal. The study is backed up with a detailed examination of the voucher specimen. Our record also confirms the geographical range extension of *Sufflamen fraenatum* to the north-eastern coast of India and an addition to the ichthyofaunal diversity of northern Bay of Bengal coastal waters.

ACKNOWLEDGEMENT

The authors are greatly indebted to the Director, ICAR-Central Institute of Fisheries Education, Mumbai, for support and for providing necessary facilities for this work.

REFERENCES

ALLEN, G.R. & M.V. ERDMANN (2012): Reef Fishes of the East Indies. Vols I–III. Tropical Reef Research. University of Hawai'i Press, Perth, Australia.

CHATTERJEE, T.K., RAMAKRISHNA, S. TALUKDAR & A.K. MUKHERJEE (2000): Fish and Fisheries of Digha coast of West Bengal. *Rec. zool. Surv. India, Occ. Paper No. 188*: p. 1–87. Zoological Survey of India, Kolkata.

DAS, P., S.P. De, R.M. BHOWMIK, P.K. PANDIT, R. SENGUPTA, A.C. NANDI, S.C. THAKURTA & S. SAHA (2007): Piscine diversity of West Bengal. *Fishing Chimes 27(5)*: 15–28.

FROESE, R. & D. PAULY (2016): Fishbase. World Wide Web electronic publication. www.fishbase.org (version 06/2016). http://www.fishbase.org/summary/ FamilySummary.php?ID=445/

GEORGE, A.I., M.S. NAZIR AHMED & T.N. SIVADASAN ASARI (1976): Observations on an unusually heavy landing of *Sufflamen capistratus* (Shaw) (Balistidae) along south Kerala coast during 1971–72. *Bull. Dept Fish. Kerala 1*: 1–20.

GOSWAMI, B.C.B. (1992): Marine fauna of Digha coast of West Bengal, India. *J. Mar. Biol. Ass. India 34(1–2)*: 115–137.

HUBBS, C.L. & K.F. LAGLER (1947): Fishes of the Great Lake Region. *Bulletin Cranbook Institute of Science (Bloomfield Hills, Michigan)* No. 26.

KAR, A., S.K. ROUT, M. BHATTACHARYA, S. PATRA, B.K. DAS & B.C. PATRA (2017): Marine fishes of West Bengal coast, India: Diversity and conservation preclusion. *Regional Studies in Marine Science 16*: 56–66.

KUITER, R.H. & T. TONOZUKA (2001): Pictorial Guide to Indonesian Reef Fishes. Part 3. Jawfishes–Sunfishes, Opisthognathidae–Molidae. Zoonetics, Australia, pp. 623–893.

LATREILLE, P.A. (1804): Tableau méthodique des poissons. Pp. 71–105. *In*: Nouveaux dictionnaire d'histoire naturelle, 1re éd., v. 24. Caractères et tables. Paris. 24 vols. 1803–04.

MANNA, B. & B.C.B. GOSWAMI (1985): A checklist of marine & estuarine fishes of Digha, West Bengal, India. *Mahasagar 18(4)*: 489–499.

MATSUURA, K. (2001): Balistidae. Triggerfishes. Pp. 3911–3928. *In*: Carpenter, K.E. and V. Niem (Eds): FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Vol. 6. Bony fishes Pt 4 (Labridae to Latimeriidae), Estuarine Crocodiles. FAO, Rome. Ref No [9770] Key No. [410].

MATSUURA, K. & R. FRICKE (2010): *Sufflamen fraenatum*. The IUCN Red List of Threatened Species 2010: e.T154721A4617775. http://dx.doi.org/10.2305/IUCN.UK.2010-4.RLTS.T154721A4617775.en. Downloaded on September 20, 2016.

MISHRA, S.S. & S. KRISHNAN (2003): Marine fishes of Pondicherry and Karaikal. *Rec. zool. Surv. India. Occ. Paper No. 216*: 1–52.

RAJAN, P.T., C.R. SREERAJ & T. IMMANUEL (2011): Fish fauna of coral reef, mangrove, freshwater, offshore and seagrass beds of Andaman and Nicobar Islands. Zoological Survey of India, Andaman and Nicobar Regional Centre, Haddo, Port Blair.

RAO, D.V. (2010): Field Guide to Coral and Coral Associates of Andaman and Nicobar Islands. Zoological Survey of India. Pp. 283.

SAHAYAK, S., K.K. JOSHI & V.S. MURTY (2015): Taxonomy of fishes of the family Balistidae in India. Pp. 219–272. *In*: Summer School on Recent Advances in Marine Biodiversity Conservation and Management, February 16 – March 08, Central Marine Fisheries Research Institute.

SANYAL, A.K., J.R.B. ALFRED, K. VENKATARAMAN, S.K. TIWARI & S. MITRA (2012): Status of Biodiversity of West Bengal. Published by the Director, Zoological Survey of India, Kolkata. 969 pp. + 35 plates.

SMITH, M.M. & P.C. HEEMSTRA (1986): Balistidae. Pp. 876–882. *In*: Smith, M.M. and P.C. Heemstra (Eds): Smiths' Sea Fishes. Springer Verlag, Berlin.

TALWAR, P.K., P. MUKHERJEE, D. SAHA, S.N. PAUL & S. KAR (1992): Marine and estuarine fishes. Fauna of West Bengal State Fauna Series 3, Pt 2, pp. 243–342.

THOMAS, S., M.P. SREERAM, V.S. KAKATI, K. MANISSERI MARY & GEORGE R. MARY (2011): Coral fish diversity in Netrani waters off Murudeshwar Karnataka, south India. *Indian J. Fish. 58(1)*: 45–51.

VENKATARAMAN, K., RAJKUMAR RANJAN, CH. SATYANARAYANA, C. RAGHUNATHAN & C. VENKATRAMAN (2012): Marine Ecosystems and Marine Protected Areas of India. Published by the Director, Zoological Survey of India, Kolkata. Pp. 296.

VIJAY ANAND, P.E. & N.G.K. PILLAI (2002): Habitat distribution and species diversity of coral reef fishes in the reef slope of the Kavaratti atoll, Lakshadweep, India. *J. Mar. Biol. Ass. India 45(1)*: 88–98.

YENNAWAR, P., A. MOHAPATRA & P. TUDU (2017): An account of ichthyofauna of Digha coast, West Bengal. *Rec. zool. Surv. India 117(1)*: 4–21.

Recommended Citation

Pradhan, Alakesh, B.K. Mahapatra and Debarghya Maji (2019): On the occurence of masked triggerfish *Sufflamen fraenatum* (Tetraodontiformes: Balistidae) from Digha coastal waters, West Bengal, North-East Coast of India. *J. Bombay Nat. Hist. Soc. 116*: 121–124. doi: 10.17087/jbnhs/2019/v116/108659

26. LENGTH-WEIGHT RELATIONSHIP OF A MUDSKIPPER *PSEUDAPOCRYPTES ELONGATUS* (CUVIER, 1816) FROM INDIAN SUNDARBANS[1]

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[1]Accepted May 30, 2019
First published: December 31, 2019 | doi: 10.17087/jbnhs/2019/v116/130704
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Introduction

The elongate Mudskipper *Pseudapocryptes elongatus* is distributed in the Indo-West Pacific regions. This species inhabits muddy coastal areas and estuarine mudflats (Dinh *et al.* 2007). *Pseudapocryptes elongatus* is air breathing and amphidromous in nature (Graham 1997). This fish is generally found in tidal pools and mudflats of Ganga River in the north to the estuarine zone of Cauvery River in southern India (Appa Rao and Sreeramulu 2006). *P. elongatus* is an important commercial fish in the coastal areas of the Mekong River Delta, south of Vietnam (Minh *et al.* 2010). In the Sundarbans, mudskippers are greatly diversified due to favourable environmental conditions and hence a wide variety of mudskipper species are recorded (Mukherjee *et al.* 2013). In Gujarat, India, fishing communities of Bhavnagar and Bharuch districts are highly skilled in mudskipper fishing; they earn their livelihood by catching and selling mudskippers (Gadhavi *et al.* 2017), while the traditional fisher folk of Sundarbans (West Bengal) consume them like other edible fishes (Ravi *et al.* 2013). To the best of our knowledge, no previous reports on length-weight relationship and condition factor (Kn) of *P. elongatus* is available from the Indian Sundarbans, therefore, the present study was undertaken.

Material and methods

Specimens of *Pseudapocryptes elongatus* were collected seasonally from the Sundarban mangroves near Namkhana and Diamond Harbour (21° 42′ 30″ N; 88° 18′ 10″ E) using scoop net, cast net, and hand picking for a period of two years, from January 2015 to December 2016 (Fig. 1). The data has been segregated according to the sex and estimates were made separately for males, females, and indeterminates. A total of 526 specimens (205 males, 225 females, and 96 indeterminates) ranging from 10.0 to 20.2 cm in total length (TL) were used for the present study (Fig. 2). The total length was measured to the nearest millimetre (0.1 mm) and weight (W) was measured with 0.01 gm accuracy.

The length-weight relationship was calculated by following the equation $W = aTL^b$ (Froese 2006), where W = total body weight in gram, TL = total body length in centimetres; 'a' is constant and 'b' is slope of regression line. The values of 'a' and 'b' were estimated through a logarithmic transformation; log W = log a + b log TL, by the least square linear regression method (Froese 2006). The coefficient of determination (r^2) was estimated as an indicator of the quality of linear regression. The null hypothesis that b = 3 was tested using two-tailed t-test as described by Zar (1999). T-test analysis was carried out for the length and weight data to confirm the significance of the relationship at $P<0.05$ (Zar

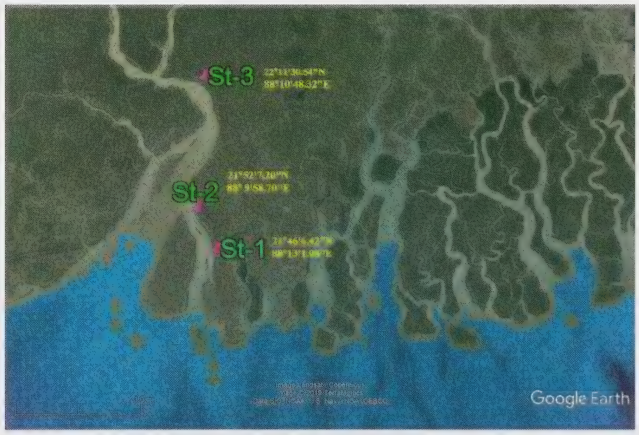

Fig. 1: Map showing the study areas

Fig. 2: *Pseudapocryptes elongatus* (Cuvier 1816)

Table 1: Length-weight relationship parameters of *P. elongatus*, from Indian Sundarbans during January 2015 to December 2016

Species	N	Size range (TL) cm	Weight range gm	Regression parameters			*p*	Errors of estimation		
				a	b	r^2		(b-3)	Sb (±)	b-3/ Sb
Males	205	10.0–19.7	10.2–22.1	0.005	2.729	0.968	< 0.005	-0.271	0.167	1.62
Females	225	10.5–20.2	11.1–24.5	0.007	2.778	0.976	< 0.005	-0.222	0.153	1.45
Indeterminates	96	3.5–9.9	2.3–9.5	0.010	2.009	0.625	>0.005	-0.991	0.174	5.69
Total population (M+F+I)	526	10.0–20.2	10.2–24.5	0.013	2.668	0.954	< 0.005	-0.332	0.189	1.80

Notes: N = sample size, a = intercept of regression curve, b = growth coefficient, r^2 = determination coefficient, *P* = significance level, (b-3) = growth coefficient-3, (Sb) = standard error of 'b', b-3/Sb= t-test, M = Male, F = Female, I = Indeterminates

1984). The deviation of regression coefficient ('b') from the isometric value of 3 was tested using the following equation (King 1995): t = b-3/sb

where 'b' is the regression coefficient, 3 the constant indicating isometric growth and sb = standard deviation of the slope. The seasonal mean relative condition factor (Kn) was calculated using the following equation: $Kn = W_0/W$ where Kn = condition factor, W_0 = observed weight and W = expected weight of each size group calculated from the length-weight relationship.

Results

The total body weight of male *Pseudapocryptes elongatus* ranged from 10.2–22.1 gm, female 11.1–24.5 gm and indeterminates varied from 2.3–9.5 gm. Descriptive statistics and the estimated length and weight parameters of *P. elongatus* are presented in Table 1 and Fig. 3.

The growth coefficient 'b' value was approximately similar for male, female and total population but it varied for indeterminates. The coefficient of determination (r^2) for both male and female was higher than 0.95 and linear regression

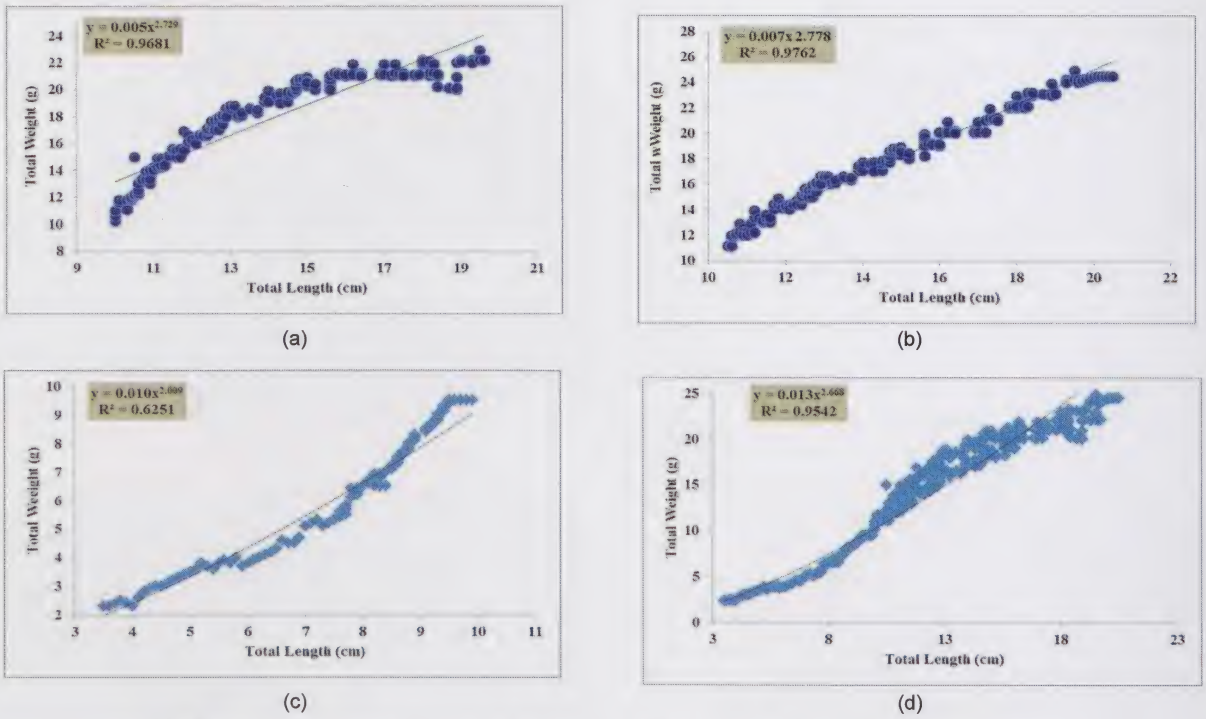

Fig. 3: Parabolic relationship between length and weight of (a) males, (b) females, (c) indeterminates, and (d) total population of *Pseudapocryptes elongatus*

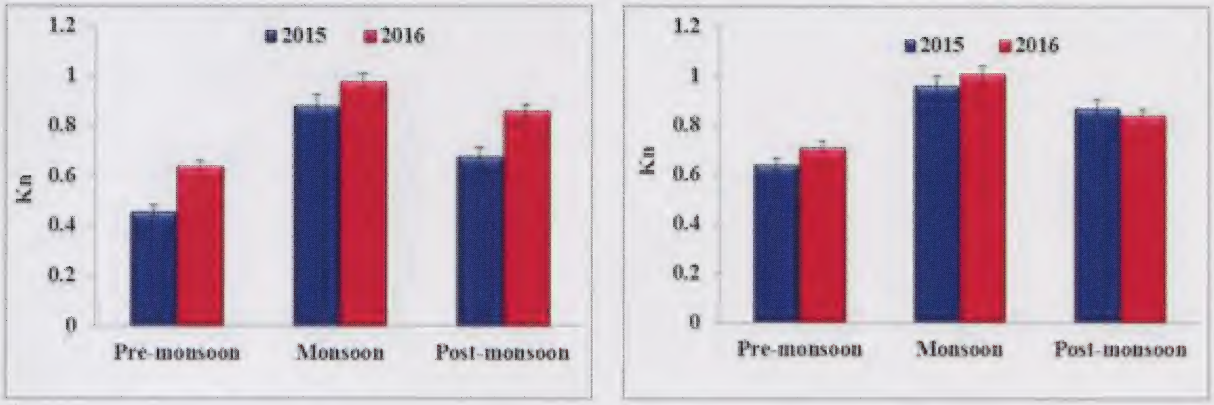

Fig. 4: Relative condition (Kn) of *Pseudapocryptes elongatus* (a) males and (b) females

of these two sexes was highly significant (p<0.005) but for indeterminates it was less significant (p>0.005) (Table 1 and Fig. 3). The growth coefficient 'b' value of females (2.778) was comparatively higher than the males (2.729) and total population (2.668) of *P. elongatus*. The growth coefficient 'b' value of indeterminates (2.009) was much lower than the males and females. The correlation coefficient values (r) of males (0.968), females (0.976) and of total population (0.954) was highly significant (p<0.005) with high degree of positive correlation between total body length and weight. The correlation coefficient values (r^2) for indeterminates (0.625) varied significantly (p>0.005).

The values of Kn showed fluctuations during various seasons in both males and females (Fig. 4). The Kn values (mean) in males varied between 0.50 (± 0.15 SE) and 0.98 (± 0.14 SE) during pre-monsoon and monsoon respectively, whereas in females Kn varied between 0.64 (± 0.09 SE) and 1.01 (± 0.11 SE) during pre-monsoon and monsoon respectively. Two-way ANOVA of males (F = 0.93; p> 0.5) and females (F = 0.87; p> 0.5) indicated no significant differences in Kn values.

Discussion

From the regression equations obtained in the present study, the exponent of length-weight relationship for male (2.729), female (2.778) and the total population (2.668) of *Pseudapocryptes elongatus* did not deviate significantly from the isometric value of '3'. In indeterminates (2.009) it deviated significantly, showing negative allometric growth. It may be concluded that during early stages of life, the fish grows allometrically and after attaining sexual maturity it grows isometrically, more or less obeying cube law. Siddique *et al.* (2015) estimated growth coefficient (2.660) for *P. elongatus*, which indicated allometric growth (b < 3) from the Bakkhali River estuary, Bangladesh. Khaironizam and Norma Rashid (2002) reported isometric growth (2.81) in *P. elongatus* from coastal waters of Malaysia. Appa Rao and Sreeramulu (2006) reported allometric growth (b<3) of *P. lanceolatus* males (2.1365) and females (2.2865) from Vasista Godavari estuary, India. Bucholtz and Meilvang (2005), while studying the biology of the mudskipper *P. elongatus*, found significant variations in growth pattern between males and females in the Mekong River Delta, Vietnam. The work done by Bucholtz *et al.* (2009) on *P. elongatus* from Mekong River Delta, Vietnam showed similar results as that of the present study. Dinh *et al.* (2007) also observed negative allometric growth in both the sexes in the Mekong River Delta, Vietnam. The 'b' values differ because of season, habitat, gonad maturity, sex, and stomach fullness (Wootton 1990).

In the present study, the Kn values were found higher in females than in males during various seasons. According to Le Cren (1951), the relative condition factor (Kn) is an indicator of general well-being of the fish. Kn value greater than one (1) is indicative of good condition, whereas a value less than one (1) stands for poor condition. Kn values of the present study varied between 0.46 and 1.01 in both the sexes. The condition factor of fishes is reported to be influenced by several factors, such as the onset of maturity (Doddamani *et al.* 2001), spawning (Al-Daham and Wahab 1991), and pollution (Devi *et al.* 2008). The results of the present study conclude that the health of *P. elongatus* in Sundarban mudflats is in good condition for both sexes.

Despite the abundance of mudskippers in the Sundarbans, they are still poorly known and very few reports are available on their biology and ecology. It is hoped that this study will contribute to the knowledge of mudskipper populations in

this area and will serve as valuable baseline information and be useful for stock and age and growth estimation of *P. elongatus* in Sundarban mangroves.

Conflict of interest statement

The authors declare that they do not have any conflict of interest in relation to this publication.

ACKNOWLEDGEMENTS

The authors are grateful to the Director & Dean, CAS Marine Biology and the authorities of Annamalai University, for providing necessary facilities. The authors sincerely thank the Ministry of Human Resource & Development [G4 (1)/1630/2013], New Delhi, for financial support.

REFERENCES

Al-Daham, N.K. & N.K. Wahab (1991): Age, growth and reproduction of the greenback mullet *Liza subviridis* (Valenciennes), in an estuary in southern Iraq. *J. Fish Biol. 38*: 81–88.

Appa Rao, K.V.C.S & K. Sreeramulu (2006): Length weight relationship of the Gobiid fish *Pseudapocryptes lanceolatus* (Bloch and Schneider, 1801) of the Vasista Godavari estuary, East coast of India. Pp. 154–160. *In*: Arvind Kumar and Pushpalata Dubey (Eds): Fish Management and Aquatic Environment. Daya Publications, Delhi.

Bucholtz, R.H. & A.S. Meilvang (2005): Biology and utilization of the mudskipper *Pseudapocryptes elongatus* in the Mekong River Delta, with aspects on other mudskippers in the area. M.Sc. (Hons) Thesis, Department of Marine Ecology and Centre for Tropical Ecosystem Research, University of Aarhus, Denmark. 99 pp.

Bucholtz, R.H., A.S. Meilvang, T. Cedhagen & J.T. Christensen (2009): Biological observations on the mudskipper *Pseudapocryptes elongatus* in the Mekong Delta, Vietnam. *J. W. Aqua. Soc. 40(6)*: 711–723.

Devi, J.O., T.S. Nagesh, S.K. Das & B. Mandal (2008): Length-weight relationship and relative condition factor of *Pampus argenteus* (Euphrasen) from Kakdwip estuarine region of West Bengal. *J. Inland Fish. Soc. India 40(2)*: 70–73.

Dinh, T.D., M.A. Ambak, A. Hassan & N.T. Phuong (2007): Biology and population dynamics of the Goby *Pseudapocryptes elongatus* in the coastal mud flat areas of the Mekong Delta, Vietnam. *Pakistan J. Biol. Sci. 10(19)*: 3284–3294.

Doddamani, M.T.J. Ramesh & S.L. Shanbhogue (2001): Length-weight relationship and condition factor of *Stolephorus bataviensis* from Mangalore area. *Indian J. Fish. 48(3)*: 329–332.

Froese, R. (2006): Cube law, condition factor and weight–length relationships: history, meta-analysis and recommendations. *J. Appl. Ichthyol. 22(4)*: 241–253.

Gadhavi, M.K., D. Kukadia, S. Dar, N. Gokulakannan, G. Talukdar, K. Sivakumar & G.V. Gopi (2017): Indigenous techniques of catching mudskipper in Bhavnagar and Bharuch districts, Gujarat. *Indian Journal of Traditional Knowledge 16(3)*: 533–538.

Graham, J.B. (Ed.) (1997): Air-breathing fishes: Evolution, diversity, and adaptation. Academic Press, San Diego. 299 pp.

Khaironizam, M.Z. & Y. Norma Rashid (2002): Length-weight relationship of mudskippers (Gobiidae: Oxudercinae) in the coastal areas of Selangor, Malaysia. *Naga. 25*: 20–22.

King, M. (1995): Fisheries biology, assessment and management. Oxford, UK: Fishing News Books. pp. 79–192.

Le Cren, C.D. (1951): The length-weight relationship and seasonal cycle in gonad weight and condition in the Perch *Perca fluviatilis*. *J. Anim. Ecol. 20*: 201–219.

Minh, T.H., W.G. Gallardo & N.T. Phuong (2010): Fishery and aquaculture of juvenile mudskipper *Pseudapocryptes elongatus* (Cuvier, 1816) in the coastal zone of Mekong Delta, Vietnam. *Asian Fisheries Science 23(2)*: 224–239.

Mukherjee, S., A. Chaudhuri, N. Kundu, S. Mitra & S. Homechaudhuri (2013): Comprehensive analysis of fish assemblages in relation to seasonal environmental variables in an estuarine river of Indian Sundarbans. *Estuaries and Coasts 36(1)*: 192–202.

Ravi, V., G. Mahadevan & R. Bharathi (2013): Mudskipper Fishery at Namkhana Region, Sundarban Mangrove Forests, India. *Fishing Chimes 33(4)*: 42–44.

Siddique, M.A.M., Md. S.K. Khan & M. Aktar (2015): Length-weight relationship for two gobioid fishes *Odontamblyopus rubicundus* (Hamilton, 1822) and *Pseudapocryptes elongatus* (Cuvier, 1816) from the Bakkhali River estuary, Bay of Bengal. *Zoology and Ecology 25(2)*: 106–109.

Wootton, R.J. (1990): Ecology of Teleost Fishes. Chapman and Hall, London. 404 pp.

Zar, J.H. (1984): Biostatistical Analysis. Prentice Hall, Englewood Cliffs, NJ. 718 pp.

Zar, J.H. (1999): Biostatistical Analysis. 4th edn. Pearson Education, Singapore.

Recommended Citation

Mahadevan, G., V. Ravi and P. Murugesan (2019): Length-weight relationship of a mudskipper *Pseudapocryptes elongatus* (Cuvier, 1816) from Indian Sundarbans. *J. Bombay Nat. Hist. Soc. 116*: 125–128. doi: 10.17087/jbnhs/2019/v116/130704

27. RANGE EXTENSION OF THE COMMON JAY BUTTERFLY *GRAPHIUM DOSON ELEIUS* (LEPIDOPTERA: PAPILIONIDAE) TO JAMMU, INDIA[1]

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[1]Accepted December 13, 2018
First published: April 30, 2019 | doi: 10.17087/jbnhs/2019/v116/132657
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In South Asia, the Common Jay *Graphium doson* (Felder & Felder, 1864) was known from Kumaon (Uttarakhand) eastwards to northeast India and Myanmar, and from southern India to Bengal and Sri Lanka (Evans 1932). It has recently been reported from Delhi (Smetacek 2009), Patiala (Varshney and Smetacek 2015) and Jammu (Sharma and Sharma 2017). It is believed to have colonized the Gangetic plain recently, since earlier workers failed to locate it (Ashton 1972; de Rhe-Philipe 1902; Donahue 1967; Larsen 2002).

In India, the species has two recognized subspecies known from north and south of the newly colonized Gangetic plain. The northern subspecies *G. d. axionides* (Page and Treadaway 2014) is known from northeast India and along the Himalaya as far west as Uttarakhand, where it inhabits a narrow, forested belt along the base of the foothills. The southern subspecies *G. d. eleius* (Fruhstorfer, 1907) is known from much of southern India as far north as West Bengal (Varshney and Smetacek 2015). Although the species appeared to have extended its distribution recently, it was not certain which subspecies was extending its distribution.

The two taxa are most reliably distinguished by the presence of a subcostal bar, which is connected to the basal dark band on the upper hindwing of *G. d. eleius*, but not connected to the basal dark band in *G. d. axionides*. In order to check this feature, it is necessary to examine specimens in hand, since this feature is never visible in photographs of live individuals.

Material examined for present study:

2 males: Jammu, Jammu & Kashmir ([?].vi.2015) Leg. Shakha Sharma, Coll. Smetacek, Bhimtal.

1 male: Kanpur, Uttar Pradesh (15.iii.2018) Leg. Peter Smetacek, Coll. Smetacek, Bhimtal.

In addition to the above records, *G. doson* was observed by PS in the campus of Lucknow University in March 2018, although de Rhe-Philipe (1902) did not record it from the area in more than three years of observation.

All three specimens examined in the present study clearly belong to *G. doson eleius*. Since no material has been examined from Delhi, Lucknow, or Patiala, conclusions cannot be drawn, but it is interesting that the subspecies *eleius* appears to have shifted northwards and colonized a part of what one would imagine would be the range of *P. d. axionides*, i.e. the west Himalayan foothills in Jammu.

Smetacek (2009) suggested that the introduction of *Polyalthia* species as ornamental trees in Delhi facilitated the colonization of that area by *G. doson*. This could be true for the other range records from Jammu, Kanpur, Patiala, and Lucknow, too.

The appearance of *G. d. eleius* in Jammu and Kanpur might also indicate that these populations spread along with nursery trees being shipped from places like Andhra Pradesh to the rest of the country. At least one other butterfly, *Talicada nyseus* (Guerin-Meneville, 1843), appears to have colonized northern India during this century as a result of its larval foodplants, succulents such as *Bryophyllum* and *Kalanchoe*, being shipped from southern to northern Indian states (Smetacek 2009). It is presumed that plants with eggs on them were unwittingly sent, which helped introduce the species to places like Delhi, Uttarakhand, and Himachal Pradesh.

Whatever the reason, the current records somewhat upset the concept of subspecific distribution, since it appears that *G. d. axionides* has not extended its distribution westward along the Himalaya but that the Jammu population is in fact the southern Indian *G. d. eleius*. The gap between the populations of the extant *axionides* in Uttarakhand and the new colonizer *eleius* in Jammu & Kashmir traverses the submontane tract of Himachal Pradesh. This might separate them for the time being, but it is inevitable that sooner or later the two populations will meet in northern India and it should be an interesting study to discover whether the two subspecies mingle and produce mixed offspring, or co-exist in discrete populations, or one eventually displaces the other.

REFERENCES

Ashton, R. (1972): Butterflies of New Delhi (Papilionoidea). *J. Bombay Nat. Hist. Soc. 69(3)*: 502–509.

de Rhe-Philipe, G.W.V. (1902) The butterflies of the Lucknow district. *J. Bombay Nat. Hist. Soc. 14(3)*: 481–493.

Donahue, J.P. (1967): An annotated list of the butterflies of Delhi, India. *J. Bombay Nat. Hist. Soc. 63(2)*: 235–269; *64(1)*: 22–48.

Evans, W.H. (1932): The Identification of Indian Butterflies. 2nd edn. Bombay Natural History Society, Bombay. x+454 pp., 32 pl.

Larsen, T.B. (2002): The butterflies of Delhi, India: an annotated checklist (Insecta: Rhopalocera). *Esperiana 9*: 459–479.

Sharma, S. & N. Sharma (2017): Two new species of butterflies from Jammu and neighbourhood, Jammu & Kashmir, India. *Journal of Wildlife Research 5(1)*: 10–13.

Smetacek, P. (2009): Additions to the butterflies of Delhi. *Bionotes 11(1)*: 15.

Varshney, R. & P. Smetacek (Eds) (2015): A Synoptic Catalogue of the Butterflies of India. Butterfly Research Centre, Bhimtal & Indinov Publishing, New Delhi, ii +261 pp., 8 pl. doi: 10.13140/RG.2.1.3966.2164

Recommended Citation

Sharma, Shakha, Rakesh Kumar Singh and Peter Smetacek (2019): Range extension of the Common Jay butterfly *Graphium doson eleius* (Lepidoptera: Papilionidae) to Jammu, India. *J. Bombay Nat. Hist. Soc. 116*: 129–130. doi: 10.17087/jbnhs/2019/v116/132657

28. FIRST RECORD OF *SYMBRENTHIA SILANA* (DE NICÉVILLE 1885) (LEPIDOPTERA: NYMPHALIDAE) FROM BARAIL HILL RANGE, ASSAM, INDIA AND ITS SIGNIFICANCE[1]

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[1]Accepted December 13, 2018
First published: September 30, 2019 | doi: 10.17087/jbnhs/2019/v116/117588

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Genus *Symbrenthia* Hubner, 1819 ranges across the Oriental, Southeastern Palaearctic, and Australian regions, but not Australia (Vane-Wright and de Jong 2003). The larval foodplant of this genus is *Debregasia* sp. (Urticaceae) (Kehimkar 2008; Vane-Wright and de Jong 2003). They are mostly seen near water and are generally stream dwellers. In India, a total of five species, namely Common Jester *Symbrenthia lilaea khasiana*; Spotted Jester *S. hypselis contada* (=*sinsilis*, *assama*); Himalayan Jester *S. brabira*; Bluetail Jester *S. niphanda*, and the Scarce Jester *S. silana* have so far been recorded and all of them occur in Eastern Himalaya and north-east (NE) India (Evans 1932).

Barail Hill Range (24° 58′–25° 50′ N; 92° 50′–92° 52′ E), a south-western extension of Patkai range, is one of the largest hill ranges of NE India, starting from southern Assam till Kohima district of Nagaland. On December 25, 2014, one male *Symbrenthia silana* was recorded for the first time from Barail Hill Range in Southern Assam. The species was recorded at an elevation of 850 m in Nemotha (Cachar peak), southern Assam (92° 48.895′ N; 25° 0.847′ E). The record is significant, being the first from Assam. The species is also endemic to Eastern Himalaya and NE Hills, and has been reported as 'very rare', with a narrow distribution range from Sikkim to Manipur (Evans 1932). In India, the species is legally protected under Schedule I of the Wildlife (Protection) Act, 1972.

Due to the short duration of our study, we could record only four species of *Symbrenthia*, namely *S. lilaea*, *S. hypselis*, *S. niphanda*, and *S. silana*. We did not record *S. brabira* during our survey, but it has been previously recorded from Kohima district in Nagaland (Tytler 1915). The reason for the absence of *S. brabira* is that it occurs only at higher elevations in NE India and our surveys hardly covered any elevation above 2,000 m. We also did not record *S. silana* in Nagaland, despite the sites being within the potential elevation zone for the species.

Distinguishing Characters: Upperside of *Symbrenthia silana* has an ochreous band below the apex which is wide (de Nicéville 1885) (Figs 2, 4 and 6), but narrower than in *S. niphanda* (Fig. 8). In dry season form (Fig. 2), the rufous

Fig. 1: *Symbrenthia silana* (UN), Nemotha (Cachar peak) ♂ (December 25, 2014)

Fig. 2: *Symbrenthia silana* (UP), Nemotha (Cachar peak) ♂ (December 25, 2014)

Fig. 3: *Symbrenthia silana* (UN), BNHS 3799 ♂ Takda, Teesta Valley, 1,524 m above mean sea level, Collector Unknown; Date of Collection - April 1950

Fig. 4: *Symbrenthia silana* (UP), BNHS 3799 ♂ Takda, Teesta Valley, 1524 m above mean sea level, Collector Unknown; Date of Collection - April 1950

band on the upperside is much wider (Tytler 1915). Apical spots present. Subapical streak reaches costa; underside post-discal markings on forewing round and never metallic green in *S. silana* but metallic green in *S. niphanda* (Evans 1932). The metallic green spots are very narrow in *S. niphanda* (Fig. 7) but wider in *S. silana* (Figs 1, 3 and 5). All markings appear much darker; much broader band of ground colour separates subterminal cones from terminal markings; anterior edge of terminal lunules in vein 2, 3 very irregular (Tytler 1915).

The species has been reported in fair numbers from Manipur (Tytler 1915). Besides, it has been recorded from Nagaland, Sikkim, Arunachal Pradesh, and Garo Hills (Kunte 2010; Tytler 1915). According to Evans (1932), status of the species was "very rare"; elevation: 600 – 1,800 m (de Nicéville 1886; Kehimkar 2008; Kunte 2010; Tytler 1915).

Altitudinal migration in *Symbrenthia silana*

In Eastern Himalaya in the late 1800s, *Symbrenthia silana* was recorded from lower elevations in Sikkim (600 m) during winter, and higher elevations (1,800 m) in Sikkim, Buxa Bhutan border during summer (de Nicéville 1886). During extreme summer (July–October), *Symbrenthia silana* was reported from the hills of NE India (1,830 m in Kirbari, Naga Hills) in the 1900s. Interestingly, in winter (February to April) the dry season forms were reported at lower elevations (1,300 m) in Sebong, East Manipur Hills, and Irang river, West Manipur Hills (Tytler 1915). Similarly, our record of the extremely dry season form of this species at 850 m during December suggests that the species is capable of migrating here, probably from West Manipur Hills and Kohima district of adjoining Nagaland to lower elevations of Barail Hill Range in Southern Assam, from 1,800 m down to 600–800 m during extreme winter. According to Kunte (2010), *Symbrenthia silana* was rediscovered after a period of 90 years (from North Sikkim and West Sikkim, Namdapha National Park, Arunachal Pradesh, and Nokrek National Park, Garo hills, Meghalaya), the last record being that of Tytler in 1915. However, there are specimens of *S. silana* in the collections of the Bombay Natural History Society (BNHS) from Teesta valley, Sikkim which had been collected during 1948–1950 (Figs 3–6). Therefore, the last historical record for the species should have been 1950, and not 1915.

Fig. 5: *Symbrenthia silana* (UN), BNHS 3800
Teesta Area 365.76 m above msl, Collector Unknown
Date of Collection - April 21, 1948

Fig. 6: *Symbrenthia silana* (UP), BNHS 3800
Teesta Area 365.76 m above msl, Collector Unknown
Date of Collection - April 21, 1948

Fig. 7: *Symbrenthia niphanda* (UN) for comparison with *S. silana*
BNHS 3801♂ Locality - Nallah, Darjeeling, 1371.6 m above msl,
Collector Unknown, Date of Collection - April 24, 1923

Fig. 8: *Symbrenthia niphanda* (UP) for comparison with *S. silana*
BNHS 3801♂ Locality - Nallah, Darjeeling, 1,371.6 m above msl.
Collector Unknown, Date of Collection - April 24, 1923

Now, the concern is that most of the locations of previous records of *Symbrenthia silana* from Manipur are deforested. In Assam, it was very likely that the species would occur only in North Cachar, it being the only elevated area in Assam. The known elevation range of the species is 600–1,800 m (Kunte 2010), therefore it is not likely to occur in Upper Assam or West Assam, which are below this elevation. *S. silana* has not been reported from Eastern Assam (according to Singh 2017b). Also, in 2013–2014, the species has been sighted from a few more localities: Eaglenest Wildlife Sanctuary (East Arunachal) and Mouling National Park, Arunachal Pradesh (West Arunachal) which shows that it also occurs in Eastern Himalayan range of Arunachal Pradesh (unpublished records). Further research on the distribution range of this species may also help in evaluating the conservation significance of Nemotha (Cachar peak), which is also under threat today due to heavy logging. Cachar peak is significant because it is also the type locality of the endemic and rare Cachar Mandarin Blue *Charana cepheis*, and is the lone peak in Barail Wildlife Sanctuary, Assam. Besides these, the species has also not been reported during recent surveys from Nagaland (Naro and Sondhi 2014) and Arunachal Pradesh (Singh 2017 a,c).

ACKNOWLEDGEMENTS

We thank the Head, Department of Ecology and Environmental Science, Assam University, Silchar, for support. We are thankful to the Forest Department, Govt of Assam, for permission to work in Barail Wildlife Sanctuary. MJG acknowledges the UGC-BSR fellowship for financial support. MJG and RK also thank Dr Deepak Apte, Director BNHS for his support and encouragement.

REFERENCES

DE NICÉVILLE, L. (1885): Descriptions of some new Indian Rhopalocera. Part 2 Nat Sci. *J. Asiatic Soc. Bengal 54*: 117–124.

DE NICÉVILLE, L. (1886): The Butterflies of India, Burma and Ceylon. Vol II. Nymphalidae, Lemoniidae, Libythaeinae, Nemeobinae. The Calcutta Central Press Co. Ltd, 332 pp.

EVANS, W.H. (1932): The Identification of Indian Butterflies. 2nd edn. Bombay Natural History Society, Bombay. x + 454 pp + 32 pl.

KEHIMKAR, ISAAC (2008): The Book of Indian Butterflies. Bombay Natural History Society and Oxford University Press, New Delhi, xvi + 497 pp.

KUNTE, K. (2010): Rediscovery of the federally protected Scarce Jester Butterfly *Symbrenthia silana* de Nicéville, 1885 (Nymphalidae: Nymphalinae) from the Eastern Himalaya and Garo Hills, northeastern India. *Journal of Threatened Taxa 2(2)*: 858–866. doi.org/10.11609/JoTT.o2371.858-66

NARO, T. & S. SONDHI (2014): Butterflies (Lepidoptera) of Chizami, Phek District, Nagaland, India. *Journal of Threatened Taxa 6(13)*: 6593–6634. doi.org/10.11609/JoTT.o3995.6593-634

SINGH, A.P. (2017a): Butterflies associated with major forest types in Arunachal Pradesh (Eastern Himalaya), India: Implications for eco-tourism and in conservation planning. *Journal of Threatened Taxa 9(4)*:10047–10075.

SINGH, A.P. (2017b): Butterflies of eastern Assam, India. *Journal of Threatened Taxa 9(7)*: 10396–10420.

SINGH, A.P. (2017c): Rare and interesting butterfly (Lepidoptera) records from Arunachal Pradesh, India. *J. Bombay Nat. Hist. Soc. 113(3)*: 138–164.

TYTLER, H.C. (1915): Notes on some new and interesting butterflies from Manipur and the Naga Hills. *J. Bombay Nat. Hist. Soc. 23(2)*: 502–515.

VANE-WRIGHT, R.I. & RIENK DE JONG (2003): The butterflies of Sulawesi: annotated checklist for a critical island fauna. *Zoologische Verhandelingen 343*: 3–267.

Recommended Citation

Gogoi, Monsoon Jyoti, Hilloljyoti Singha, Panna Deb and Rahul Khot (2019): First record of *Symbrenthia silana* (de Nicéville 1885) (Lepidoptera: Nymphalidae) from Barail Hill Range, Assam, India and its significance. *J. Bombay Nat. Hist. Soc. 116*: 130–133. doi: 10.17087/jbnhs/2019/v116/117588

29. A NEW COUNTRY RECORD OF *LANGIA ZENZEROIDES ZENZEROIDES* MOORE, 1872 (SPHINGIDAE: SMERINTHINAE) FROM BHUTAN[1]

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[1]Accepted December 11, 2018
First published: April 30, 2019 | doi: 10.17087/jbnhs/2019/v116/130270

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Introduction

The genus *Langia* Moore, 1872 belongs to subfamily Smerinthinae of family Sphingidae. It is a widely distributed Palaeo-Oriental/Australian species (D'Abrera 1987). The genus consists of only two species *Langia tropicus* Moulds, 1983 which is distributed in Australia (D'Abrera 1987) and *Langia zenzeroides* Moore, 1872 which is distributed from West and East Himalaya to Japan (Bell and Scott 1937; Savela 2018).

Langia zenzeroides Moore, 1872 is known to have three subspecies: (i) *Langia zenzeroides zenzeroides* Moore, 1872; (ii) *Langia zenzeroides nawai* Rothschild & Jordan, 1903; and (iii) *Langia zenzeroides formosana* Clark, 1936 (Pittaway and Kitching 2018). Of these, the nominate *L. z. zenzeroides* Moore, 1872 is widely distributed on the Asian mainland in northern Pakistan (Rawalakot, Khyber Pakhtunkhwa) (Rafi *et al.* 2014); India (Himachal Pradesh, Uttarakhand, Sikkim, Meghalaya, Nagaland) (D'Abrera 1987; Dudgeon 1898; Smetacek 1994, 2008); Nepal (Godavari) (Haruta 1993); eastern and southern China (Beijing, Zhejiang, Hubei, Sichuan, Yunnan, Guizhou, Fujian, Guangxi, Hainan, Wenchang City) (Pittaway and Kitching 2018); South Korea (Gangwon-do, Gyeonggi-do, Gyeongsangnam-do, Gyeongsangbuk-do, Jeollanam-do, Jeollabuk-do, Chungcheongnam-do, Chungcheongbuk-do, Jeju Island) (Han *et al.* 2015); northern Thailand (Inoue *et al.* 1997); Vietnam (Laokai, Mt Fan-Si-Pan) (Kitching and Spitzer 1995) (Fig. 1). The larvae of the subspecies feed on trees of the woody family Rosaceae, such as cherry, apple, pear, and medlar (D'Abrera 1987; Inoue *et al.* 1997). In Korea it was found feeding on peach (Park *et al.* 1999).

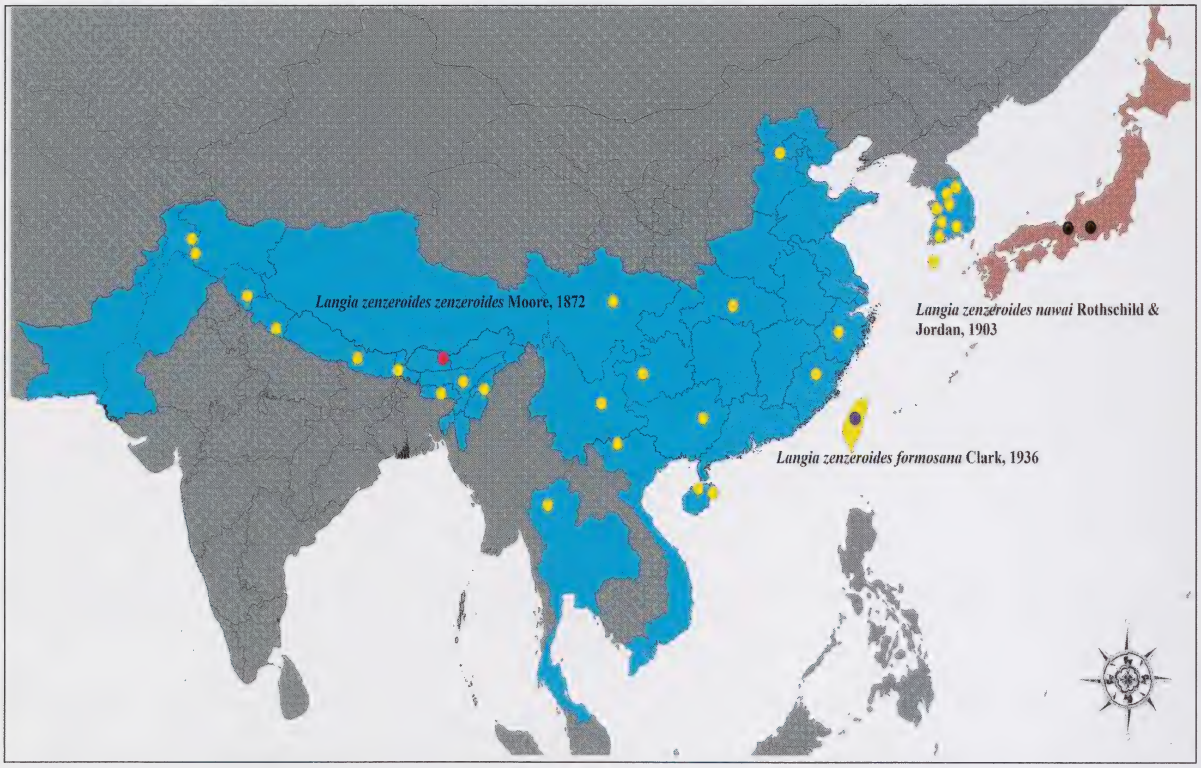
Langia zenzeroides zenzeroides Moore, 1872
Langia zenzeroides nawai Rothschild & Jordan, 1903
Langia zenzeroides formosana Clark, 1936

Fig. 1: Distribution range of three subspecies of *Langia zenzeroides*; *L. z. zenzeroides*, *L. z. nawai* and *L. z. formosana*. (Prepared using DIVA-GIS 7.5.0 by Jatishwor Singh Irungbam)
Yellow Circle: Historical sighting locations of *L. z. zenzeroides*; Red Circle: Present sighting location of *L. z. zenzeroides* in Bhutan; Black Circle: *L. z. nawai* endemic to Japan; Blue Circle: *L. z. formosana*, endemic to Taiwan.

As stated in Bell and Scott (1937), the adult of subspecies *L. z. zenzeroides* has a wingspan of 112–152 mm. It is characterized by: Head pale; vertex of thorax with ochreous lines and sides dark brown; light and dark brown spatulate scales covering abdomen and metathorax. Forewing costal area leaden-grey, whitish below cell, dark grey towards inner and outer margins; three very oblique dark lines from apex to near centre of inner margin. Hind wing brown with some dark brown and whitish lines near anal angle; a marginal dark line and cilia whitish towards anal angle.

Sighting

The hawkmoth was encountered on the night of May 03, 2018, near a residential colony of Yangtshe town (27° 36′ 33.869″ N, 91° 29′ 55.276″ E; 1,728 m above mean sea level) in Trashiyangtse district, Eastern Bhutan (Fig. 1). The vegetation in the neighbourhood was dominated by walnut, pear, and mulberry trees. The moth was photographed by the second author using digital camera (Eds: photographic evidence provided). Later, the species was identified by the first author referring to literature of D'Abrera (1987), Haruta (1993), and Inoue *et al.* (1997). The status of the species was confirmed to be a new record for the country by Dr Ian J. Kitching, Natural History Museum, London (UK) and Mr Peter Smetacek, Butterfly Research Centre, Bhimtal (India) through social media communication (19 July, 2018).

Discussion

Earlier studies on the moths of Bhutan have not recorded the species. Dudgeon (1898) who conducted studies on the moths of Sikkim and Bhutan recorded the species from Kurseong, Sikkim at 1,524 m, but not from neighbouring Bhutan. In 1972, entomologists from the Natural History Museum, Basel (Switzerland) undertook an expedition to study the moth fauna of Bhutan. They reported the presence of 10 species of Sphingidae, but not *Langia zenzeroides* (Dierl 1975). Recent studies by Irungbam and Kitching (2014) at Tsirang district in southern Bhutan reported the presence of 27 species of Sphingidae but they also did not record *L. zenzeroides* from the southern part of Bhutan. Thus, the present sighting in Trashiyangtse district of Eastern Bhutan is significant. It is the first and confirmed record of the species from Bhutan.

Table 1: Historical sighting locations of *Langia zenzeroides zenzeroides* throughout its distribution range (based on available literature)

Sr. No	Historical sighting locations	Latitude	Longitude	Altitude	Reference
1	Yangtse town, Trashiyangtse, Bhutan	27.609408	91.498688	1728	Present record
2	Kotgarh, Himachal Pradesh, India	31.31137	77.474489	1932	Moore, 1872 (Type Locality)
3	Kurseong, India	26.878892	88.277752	1491	Dudgeon, 1898
4	Meghalaya, India	25.467031	91.366216	1527	Smetacek, 1994
6	Jones Estate, Bhimtal, Uttarakhand, India	29.35576	79.543761	1420	Smetacek, 2008
7	Phek, Nagaland, India	25.737465	94.43879	1161	Moths of India website
8	Rawalakot, Pakistan	33.858373	73.765437	1670	Rafi *et al.* 2014
9	Khanian, Khyber Pakhtunkhwa, Pakistan	34.729886	73.504193	1750	Rafi *et al.* 2014
10	Godavari, Nepal	27.601563	85.365296	1439	Haruta, 1993
11	Lao Cai, Vietnam	22.480943	103.975496	90	Kitching & Spitzer 1995
12	Chapa, Mt Fan-Si-Pan, Vietnam	22.25	103.766667	1800	Kitching & Spitzer 1995
13	Chiang Mai, Thailand	18.787747	98.993128	312	Inoue *et al.* 1997
14	Gangwon-do, South Korea	37.8228	128.1555	383	Han *et al.* 2015
15	Gyeonggi-do, South Korea	37.4138	127.5183	44	Han *et al.* 2015
16	Gyeongsangnam-do, South Korea	35.4606	128.2132	471	Han *et al.* 2015
17	Jeollanam-do, South Korea	34.8679	126.991	192	Han *et al.* 2015
18	Jeollabuk-do, South Korea	35.7175	127.153	449	Han *et al.* 2015
19	Chungcheongnam-do, South Korea	36.5184	126.8	108	Han *et al.* 2015
20	Chungcheongbuk-do, South Korea	36.8	127.7	219	Han *et al.* 2015
21	Jeju Island, South Korea	33.372267	126.595237	1127	Han *et al.* 2015
22	Baihua Mountain, Mentougou, China	39.857438	115.616183	1791	Pittaway & Kitching, 2018
23	Zhejiang, China	29.141643	119.788925	58	Pittaway & Kitching, 2018
24	Hubei, China	30.737812	112.238402	61	Pittaway & Kitching, 2018
25	Dujiangyan, Sichuan, China	30.988434	103.646912	706	Pittaway & Kitching, 2018
26	Kunming, Yunnan, China	24.880095	102.832891	1930	Pittaway & Kitching, 2018
27	Guizhou, China	26.663449	105.770542	1319	Pittaway & Kitching, 2018
28	Nanping, Fujian, China	26.641774	118.17771	86	Pittaway & Kitching, 2018
29	Dayao Shan, China	24	110.108889	899	Pittaway & Kitching, 2018
30	Duowenling, Hainan, China	19.791538	109.766057	176	Pittaway & Kitching, 2018
31	Wenchang, Hainan, China	19.543278	110.797759	8	Pittaway & Kitching, 2018

ACKNOWLEDGEMENTS

The authors are thankful to Dr Ian J. Kitching, Natural History Museum, London (UK) and Mr Peter Smetacek, Butterfly Research Centre, Bhimtal (India) for confirming the species and for their valuable comments. The first author is thankful to Czech Science Foundation (GA CR: 14-36098G) and Grant Agency, University of South Bohemia (GA JU 038/2019/P) for support during the preparation of manuscript.

REFERENCES

Bell, T.R.D. & F.B. Scott (1937): The Fauna of British India, including Ceylon and Burma. Moths. 5 Sphingidae. Taylor and Francis Ltd, London, xviii + 537 pp., 15 pls, 1 map.

d'Abrera, B. (1987): Sphingidae Mundi. Hawk Moths of the World. Based on a checklist by Alan Hayes and the collection he curated in the British Museum (Natural History). E.W. Classey, Faringdon. 226 pp.

Dierl, W. (1975): Ergebnisse der Bhutan-Expedition 1972 des Naturhistorischen Museums in Basel, Einige Familien der "bombycomorphen" Lepidoptera. *Entomologica Basiliensia 1*: 119–134.

Dudgeon, G.C. (1898): A catalogue of the Heterocera of Sikhim

and Bhutan. With notes by H.J. Elwes and additions by Sir George F. Hampson. Part II. *J. Bombay Nat. Hist. Soc. 11(2)*: 406–419.

Han, Y-G, Y. Cho, O. Kwon, Y-K. Kang, Y-J. Park, Y. Kim, M-J. Choi & S-H. Nam (2015): A study of the spatio-temporal distribution changes of the Korean Hawk Moths (Lepidoptera: Sphingidae). *Journal of Ecology and Environment 38(1)*: 25–38.

Haruta, T. (1993): Sphingidae. *In*: Haruta, T. (Ed.): Moths of Nepal, Part 2. *Tinea 13 (Suppl. 3)*: 146–147. 63 pl.

Inoue, H., R.D. Kennett & I.J. Kitching (1997): Sphingidae. *In*: Pinratana, A. (Ed.): Moths of Thailand. Vol. 2. Chok Chai Press, Bangkok, 149 pp.

Irungbam, J.S. & I.J. Kitching (2014): A first record of *Clanis hyperion* Cadiou & Kitching, 1990 (Lepidoptera: Sphingidae) in Bhutan, and a preliminary checklist of the hawkmoths of Mendrelgang, Bhutan. *Journal of Threatened Taxa 6(1)*: 5386–5388.

Kitching, I.J. & K. Spitzer (1995) An annotated checklist of the Sphingidae of Vietnam. *Tinea 14*: 171–195.

Park, K.T., S.S. Kim, A. Yu Tshistjakov & Y.D. Kwon (1999): Illustrated Catalogue of Moths of Korea (I) (Sphingidae, Bombicoidea [sic], Notodontidae). *In*: Park, K.T. (Ed.): Insects of Korea Series 4. Korea Research Institute of Bioscience and Biotechnology & Center for Insect Systematics, Seoul, South Korea. Pp. iv + 359, 23 pls. [in Korean & English]

Pittaway, A.R. & I.J. Kitching (2018): Sphingidae of the Eastern Palaearctic (including Siberia, the Russian Far East, Mongolia, China, Taiwan, the Korean Peninsula and Japan). http://tpittaway.tripod.com/china/china.htm. Accessed on July 18, 2018.

Rafi, M.A., A. Sultan, I.J. Kitching, A.R. Pittaway, M. Markhasiov, M.R. Khan & F. Naz (2014): The Hawkmoth Fauna of Pakistan (Lepidoptera: Sphingidae). *Zootaxa 3794(3)*: 393–418.

Savela, M. (2018): Lepidoptera and some other life forms. http://ftp.funet.fi/index/Tree_of_life/insecta/lepidoptera/ditrysia/bombycoidea/sphingidae/smerinthinae/langia/ Accessed on July 18, 2018.

Smetacek, P. (1994): The Hawkmoths (Lepidoptera: Sphingidae) of Kumaon, N. India: A probable case of faunal drift. *Records of the Zoological Survey of India, Occasional paper no. 156*: 1–55 pp.

Smetacek, P. (2008): Moths recorded from different elevations in Nainital District, Kumaon Himalaya, India. *Bionotes 10(1)*: 5–15.

Recommended Citation

Irungbam, Jatishwor Singh and Lam Norbu (2019): A new country record of *Langia zenzeroides zenzeroides* Moore, 1872 (Sphingidae: Smerinthinae) from Bhutan. *J. Bombay Nat. Hist. Soc. 116*: 133–136. doi: 10.17087/jbnhs/2019/v116/130270

30. NEW RECORD OF *DORATOPTERA NICEVILLEI* (LEPIDOPTERA: GEOMETRIDAE: ENNOMINAE) IN MIZORAM, INDIA[1]

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[1]Accepted March 13, 2019
First published: December 31, 2019 | doi: 10.17087/jbnhs/2019/v116/132659
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Hampson (1894) erected the genus *Doratoptera* for an unusual moth with leaf-like wings, which he named in honour of Lionel de Nicéville. *Doratoptera nicevillei* Hampson, 1894 was described on the basis of a single male (*recte* female *vide* Yazaki, 1992) from 'Sikhim'. This locality probably refers to the Darjeeling area in the present state of West Bengal; present day Sikkim was usually referred to as 'native Sikkim' at the time. According to Yazaki (1992), since the female was mistaken for a male, Hampson (1894) placed it in the subfamily Oenochrominae on the basis that vein M2 of the hindwing was weak. Subsequently, Prout (1921) suggested that it should be excluded from the Oenichrominae, but did not clarify where it should be transferred. Although *Doratoptera* was transferred to the Ennominae by Fletcher and Nye (1979), no justification for this transfer was published until Yazaki (1992) confirmed its placement in Ennominae after examining male material from Nepal, where vein M2 on the hindwing is obsolete.

Sericana pherufistriga (Kiriakoff, 1963) was described on the basis of a single male from eastern China and was synonymized with *D. nicevillei* by Yazaki (1992), thereby extending the known distribution of the species from Godawari (1,600 m elevation) in central Nepal to eastern China.

Although Kim *et al.* (2015) report *D. nicevillei* from Japan, there is no evidence to support this and it must be treated as an error.

Stuning and Laszlo (2015), Sato and Fukuda (2014), and Kim *et al.* (2015) report four species in the genus *Doratoptera*, i.e. *D. lutea* (Kiriakoff, 1964) (Taiwan and China); *D. virescens* Marumo, 1923 (Korea, China, and Japan); *D. amabilis* Yazaki, 1988 (Japan), and *D. nicevillei* Hampson, 1894 (Nepal to China).

On March 26 and 27, 2017, during a visit to Murlen village (23° 38′ 97″ N, 93° 17′ 34″ E; elevation 1,636 m) in Champhai district, Mizoram, 3 individuals and 4 individuals respectively of *Doratoptera nicevillei* were recorded on an

electric light. They did not differ from Himalayan specimens in any way and are therefore placed in the nomino-typical subspecies.

This constitutes the first report of this genus and species from Mizoram. The record is interesting because this moth was previously known from the Himalayan mountain system between central Nepal and eastern China. The present record extends the known distribution considerably southwards, to the northern Arakan Yoma system, comprising the Mizo Hills (formerly Lushai Hills). Considering that the main population is Himalayan, the moth must therefore also be found in suitable localities in the ranges between the Mizo Hills and the Himalaya, that is, the Patkai Bum and Naga Hills in Nagaland, Manipur, and eastern Arunachal Pradesh as well as in the Hkakoborazi landscape in northern Myanmar.

In Taiwan, the genus is represented by *Doratoptera lutea* (Kiriakoff, 1964) which is found between 600 and 1,600 m and is univoltine, with a generation in March and April (Sato and Fukuda 2014). It is very likely that *D. nicevillei* is also univoltine, since Yazaki (1992) also reported the moth only from March and April, while our records are also from March.

REFERENCES

Fletcher, D.S. & I.W.B. Nye (1979): The Generic Names of Moths of the World, Vol. 3: Geometroidea: Apoprogonidae, Axiidae, Callidulidae, Cyclidiidae, Drepanidae, Epicopeiidae, Epiplemidae, Geometridae, Pterothysanidae, Sematuridae, Thyatiridae, Uraniidae. Trustees of the British Museum, London. xx+ 243 pp.

Hampson, G.F. (1894): The Fauna of British India, including Ceylon and Burma. Moths. Vol. 3. xxviii+ 546 pp.

Kim, J.D., K.W. Lee & K.T. Park (2015): Three species of moths new to Korea. *Journal of Asia-Pacific Biodiversity 8(4)*: 390–393. https://doi.org/10.1016/j.japb.2015.10.002

Prout, L.B. (1921): *In*: Seitz, A. (Ed.): Die Gross-Schmetterlinge der Erde: Die Gross-Schmetterlinge des Indoaustralischen Faunengebeiten. Band 12: Die Indoaustralischen Spanner in Seitz, *Gross-Schmett. Erde* 12: 292 pp., pl. 1–34, 36–41, 50.

Sato, R. & T. Fukuda (2014): Taxonomic notes on the genus *Doratoptera* (Geometridae: Ennominae) from Japan and Taiwan. *Japan Heterocerists' Journal 270*: 493–498.

Stuning, D. & G.M. Laszlo (2015): *Mohacolora* gen. n., a new genus of Ennominae (Lepidoptera: Geometridae) from South-East Asia, with description of a new species. *Zootaxa 3914(2)*: 195–200. doi: http://dx.doi.org/10.11646/zootaxa.3914.2.9

Yazaki, K. (1992): Geometridae. *In*: Haruta, T. (Ed.): Moths of Nepal. Vol. 1. *Tinea 13(Suppl. 2)*: 5–46.

Recommended Citation

Tocchawng, Lalsiampuii and Peter Smetacek (2019): New record of *Doratoptera nicevillei* (Lepidoptera: Geometridae: Ennominae) in Mizoram, India. *J. Bombay Nat. Hist. Soc. 116*: 136–137. doi: 10.17087/jbnhs/2019/v116/132659

31. NEW RECORD OF *EUCYCLODES GAVISSIMA* (LEPIDOPTERA: GEOMETRIDAE) IN THE EASTERN GHATS OF ANDHRA PRADESH, INDIA[1]

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[1]Accepted March 15, 2019
First published: December 31, 2019 | doi: 10.17087/jbnhs/2019/v116/137544

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The moth *Eucyclodes gavissima* (Walker, 1861) (Geometridae: Geometrinae) was first described from Borneo. Hampson (1895) reported it from Simla (=Shimla, Himachal Pradesh), Sikkim, and Ceylon (=Sri Lanka) in the genus *Thalassodes* Guenee, 1857. Prout (1933) treated it in *Anisozyga* Prout, 1911 but was not convinced that the generic placement was correct. Smetacek (2008) reported it from the Kumaon Himalaya. T.R.D. Bell reared the larvae in southern India *vide* Holloway (1996).

There are no records of this moth from the central part of peninsular India, so it was uncertain whether the moth occurred there and therefore the southern Indian and Sri Lankan population was connected to the Himalayan population, or whether it had a disjunct distribution like *Euploea phaenareta* (Schaller, 1785) (Nymphalidae), which occurs in Sri Lanka, the Nicobar Islands, as well as the Malay peninsula, but not on the Indian mainland.

On March 09, 2018, moths were observed to be attracted

to a mercury vapour lamp in the Junglestar Eco Resort (17.63470° N, 81.63283° E; elevation 438 m above msl), G.M. Valasa Panchayat, Maredumili Mandal near Papikonda National Park, East Godavari district, Andhra Pradesh. The study was conducted only for one night, from dusk to around 11 pm. Among the insects attracted, one individual was identified as *Eucyclodes gavissima*. It was photographed by SK and shows no variation from specimens of the Himalayan population in the collection of the Butterfly Research Centre, Bhimtal, Uttarakhand.

Eucyclodes gavissima is found in hilly regions with heavy rainfall and according to records mentioned in the literature, it occurs between 2,260 m (Shimla, Himachal Pradesh) and 438 m (the present record). In Borneo, it was recorded at 300 m elevation. In extensive experience over the past 45 years, PS has never encountered more than one or two individuals of this species attracted to a lamp each night, at any location. Besides, it is not known to migrate. Therefore, despite the paucity of material, it would seem likely that the individual recorded belongs to a population that occurs in the Eastern Ghats in Andhra Pradesh. This record would connect the known Himalayan population to the Sri Lankan one, so that despite its presumed absence from the Western Ghats, the Sri Lankan population is not an isolated one like that of *E. phaenareta*.

ACKNOWLEDGEMENTS

We are grateful to the Andhra Pradesh Forest Department for organizing the first Butterfly Meet in the state and especially to Shri J.S.N. Murthy, Chief Conservator of Forests (Retd) without whose support this would not have been possible.

REFERENCES

Hampson, G.F. (1895): The Fauna of British India including Ceylon and Burma. Moths, Vol. 3. Dr W. Junk, The Hague. xxviii + 546 pp.

Holloway, J.D. (1996): The Moths of Borneo. Part 9. Geometridae. *Malayan Nature Journal 49*:147–326. http://www.mothsofborneo.com/part-9/geometrini/geometrini_9_2.php

Prout, L.B. (1933): *In*: Seitz, A. (Ed.) 1915. Die Gross-Schmetterlinge der Erde; Die Gross-Schmetterlinge der Indo-Australischen Faunengebeites. Vol. 12. Die indoaustralischen Spanner. Alfred Kernen, Stuttgart. 356 pp., 41+1 pl.

Smetacek, P. (2008): Moths recorded from different elevations in Nainital district, Kumaon Himalaya, India. *Bionotes 10(1)*: 5–15.

Recommended Citation

Smetacek, Peter, Anant Shankar, Nandani Salaria, and C. Susanth Kumar (2019): New record of *Eucyclodes gavissima* (Lepidoptera: Geometridae) in the Eastern Ghats of Andhra Pradesh, India. *J. Bombay Nat. Hist. Soc. 116*: 137–138. doi: 10.17087/jbnhs/2019/v116/137544

32. FIRST RECORD OF *NEBULARIA USTULATA* (REEVE, 1844) FROM INDIA[1]

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[1]Accepted August 22, 2018
First published: February 28, 2019 | doi: 10.17087/jbnhs/2019/v116/122744
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Introduction

The first review of family Mitridae from Indian waters was done by Ray (1954), who recorded 25 species from the collections of the Zoological Survey of India. Subsequently, Subba Rao and Dey (1984) undertook a thorough review of family Mitridae and recorded 45 species. Until now, the species count of Mitridae from India was 60 (Subba Rao and Dey 1984; Subba Rao 2003; Surya Rao and Subba Rao 1991; Ravinesh and Biju Kumar 2015; Dey 2016), of which 24 (with the recent addition of *Quasimitra cardinalis*) occur in Lakshadweep (Apte 2019). Fedosov *et al.* (2018) recently reorganized various genera from family Mitridae based on integrative taxonomy.

Material and methods

During a survey of inter-tidal reefs at Kavaratti (10° 32′ 51.17″ N; 72° 37′ 29.08″ E) on January 30, 2018, I came across 100+ specimens of *Nebularia ustulata* (Reeve, 1844). Six specimens were collected and morphological measurements such as the shell length and shell width were recorded to the nearest millimetre. Specimens were deposited in the collections of the Bombay Natural History Society (Voucher no.: BNHS GASTRO-1902), Mumbai.

Results and Discussion

Systematic account

Phylum: Mollusca Linnaeus, 1758

Class: Gastropoda Cuvier, 1795

Table 1: Measurements of the specimens collected

Sr. No.	Length in mm	Width in mm
1	35	10
2	32	9
3	33	10
4	32	9
5	24	7
6	23	6

Subclass: Caenogastropoda Cox, 1960
Order: Neogastropoda Wenz, 1938
Superfamily: Mitroidea Swainson, 1831
Family: Mitridae Swainson, 1831
Subfamily: Cylindromitrinae Cossmann, 1899
Genus: *Nebularia* Swainson, 1840
Species: *ustulata* (Reeve, 1844)

Synonyms: *Mitra ustulata* Reeve, 1844; *Mitra* (*Mitra*) *ustulata* Reeve, 1844; *Mitra ignobilis* Reeve, 1844; *Mitra mosaica* Issel, 1869; *Mitra petrosa* Sowerby, 1874; *Mitra kamehameha* Pilsbry, 1921; *Nebularia abbatis* (Dillwyn, 1969).

Material examined: 6 specimens (Table 1)

Description

Shell fusiform ovate and elongated with 7 to 9 whorls. Body sculptured with shallow or moderately deep spiral grooves with fine spiral striae. Columella with 6–8 close-set oblique folds, outer lip thick. Colour cream with dark brown or orange spots (Fig. 1).

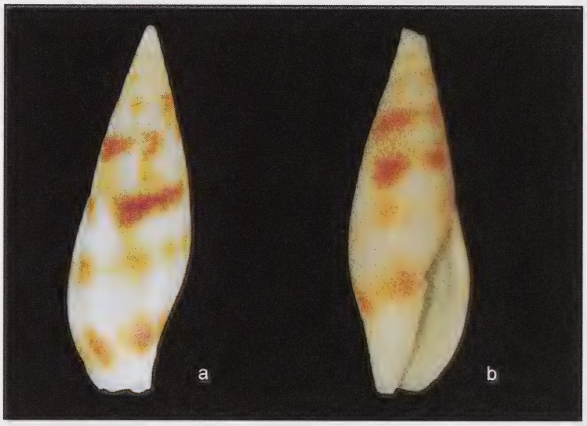

Fig. 1: *Nebularia ustulata* (Reeve, 1844)
a) abapertural view, b) apertural view

Distribution: Widespread from Red Sea to Polynesia and Hawaii Islands (Cernohorsky 1976).
INDIA: Lakshadweep.

Conclusion

With the revised taxonomy of family Mitridae (Fedosov *et al*. 2018), the genus *Nebularia* in India is now represented by four species, namely *Nebularia contracta* (Swainson, 1820), *N. acuminata* (Swainson, 1824), *N. pellisserpentis* (Reeve, 1844), and *N. incompta* (Lightfoot, 1786). The present find takes the species count for genus *Nebularia* to 5, and the total count of species from family Mitridae in the Indian waters to 61.

REFERENCES

Apte, D.A. (2019): A new record of *Quasimitra cardinalis* (Gmelin, 1791) (Mollusca, Gastropoda) from the Lakshadweep Islands, India. *J. Bombay Nat. Hist. Soc.116*: 147–148.

Cernohorsky, W.O. (1976): The Mitridae of the world. Pt 1. The subfamily Mitrinae. *Indo-Pacific Mollusca 3(17)*: 273–528.

Dey, A. (2016): Catalogue of Marine Molluscs (Polyplacophora and Gastropoda). Zoological Survey of India, Kolkata. 687 pp. + 192 pl.

Fedosov, A., N. Puillandre, M. Herrmann, Yu. Kantor, M. Oliverio, P. Dgebuadze, M.V. Modica & P. Bouchet (2018): The collapse of *Mitra*: molecular systematics and morphology of the Mitridae (Gastropoda: Neogastropoda). *Zoological Journal of the Linnaean Society XX*: 1–85, with 43 figures. https://doi.org/10.1093/zoolinnean/zlx073.

Ray, H.C. (1954): Mitres of Indian Waters (Mollusca, Gastropoda: Family Mitridae). *Memoirs of the Indian Museum 14*: 72.

Ravinesh, R. & A. Biju Kumar (2015): A checklist of the marine molluscs of Lakshadweep, India. *Journal of Aquatic Biology & Fisheries 3*: 15–55.

Subba Rao, N.V. (2003): Indian Seashells (Part I): Polyplacophora and Gastropoda. *Rec. Zool. Surv. India,* Occ. Paper. Hooghly Printing Co. Ltd, Kolkata. p. 416.

Subba Rao, N.V. & A. Dey (1984): Contribution to the knowledge of Indian marine molluscs. I. Family Mitridae. *Rec. Zool. Surv. India*, Occ. Paper No. 61, 48 pp.

Surya Rao, K.V. & N.V. Subba Rao (1991): Mollusca. Pp. 273–362. *In:* Ghosh, A.K. & A. Kumar (Eds): State Fauna Series 2, Fauna of Lakshadweep. Zoological Survey of India, Kolkata. 413 pp.

Recommended Citation

Apte, Deepak (2019): First record of *Nebularia ustulata* (Reeve, 1844) from India. *J. Bombay Nat. Hist. Soc. 116*: 138–139. doi: 10.17087/jbnhs/2019/v116/122744

33. NEW RECORD OF A LAND SNAIL *OXYTESTA SHANENSIS* (GODWIN-AUSTEN, 1883) (HELICARIONOIDEA: ARIOPHANTIDAE) FROM INDIA[1]

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[1]Accepted January 14, 2019
First published: May 31, 2019 | doi: 10.17087/jbnhs/2019/v116/122331
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Introduction

The molluscan genus *Oxytesta* Zilch, 1956 belongs to the family Ariophantidae. The genus name *Oxytes* was first coined by Pfeiffer in 1856, but since the same generic nomenclature was already given by Giebel (1848), in Malak. Bl., 2 in Fauna der Vorwelt, 1(3): 364 (Pisces) for fish, it was reassigned by Zilch (1956) as *Oxytesta*. The snails belonging to this genus are known to be distributed throughout Nepal, eastern India, Shan state of Upper Burma (now Myanmar), Siam (now Thailand), and Laos. In India, the genus is restricted to the north-eastern mountain range of Assam, Darjeeling Hills of West Bengal, Arunachal Pradesh, and Meghalaya. Ten species of genus *Oxytesta* have been described from India, namely *Oxytesta aborensis* (Godwin-Austen, 1916), *O. blanfordina* (Theobald, 1859), *O. castor* (Theobald, 1858), *O. cycloplax* (Benson, 1852), *O. oglei* (Godwin-Austen, 1918), *O. orobia* (Benson, 1848), *O. oxytes* (Benson, 1836), *O. pollux* (Theobald, 1858), *O. sylvicola* (Blanford, 1880), and *O. siyomensis* (Godwin-Austen, 1918). The species *O. shanensis*, however, has never been reported from India, although the type locality mentioned by Godwin-Austen (1883) is Shan river in Burma (= Salween river, Upper Myanmar) in the state of Upper Burma.

During the course of field work, the authors collected the land snail *Oxytesta shanensis* from Arunachal Pradesh, which is reported here as the first record from India.

Material and Methods

Field work for molluscan inventory as part of the biodiversity monitoring programme of Himalaya was carried out in Namdapha Tiger Reserve, Arunachal Pradesh in India during December 2017. The specimens were collected from the field by hand picking method (Emberton *et al.* 1996; Sajan *et al.* 2017). The collected specimens were placed in an airtight plastic container and preserved in 70% ethanol in the field, and brought to the laboratory of Malacology Division of Zoological Survey of India, Kolkata, for identification. The identification and confirmation of the species were based on published literature (Blanford and Godwin-Austen 1908; Godwin-Austen 1883).

Results

Taxonomic account:
Order: Stylommatophora Schmidt, 1855
Suborder: Helicina Rafinesque, 1815
Family: Ariophantidae Godwin-Austen, 1888
Subfamily: Macrochlamydinae Godwin-Austen, 1888

Genus *Oxytesta* Zilch, 1956
— *Archiv für Molluskenkunde*, 85 (1/3): 85.
Type specimen: *Oxytesta oxytes* (Benson, 1836)

***Oxytesta shanensis* (Godwin-Austen, 1883)** (Fig. 1)

Material Examined: 3 ex. Hornbill (27.53° N, 96.43° E, alt. 655 m above msl), Namdapha Tiger Reserve, Changlang district, Arunachal Pradesh, North-east India, Coll. S.K. Sajan, 12.xii.2017; 4 ex. Deban (27.48° N,

Fig. 1: Shells of *Oxytesta shanensis* (Godwin-Austen, 1883) from the Deban forest, Namdapha Tiger Reserve, Arunachal Pradesh, India

96.38° E, alt. 1,020 m above msl) Namdapha Tiger Reserve, Changlang district, Arunachal Pradesh, North-east India, Coll. S.K. Sajan, 23.xii.2017. The 7 collected specimens have been deposited in the National Zoological Collections in Malacology Division of Zoological Survey of India, Kolkata (Registration No. NZSI M.31137/8).

Diagnostic Characters: The shape of the shell, maximum and minimum diameter of the shell, height of the shell. The sculpture is finer and the umbilicus is smaller than *Oxytesta oxytes* (Fig. 1).

Description: Shell medium-sized, depressed and lenticular in shape; colour of the shell brownish horny; moderately thick with fine sculpture compared to *O. oxytes*; periphery sharply keeled; spire very low with obtuse apex; number of whorls 5 to 5½, flattened; last whorl sharply keeled and compressed in peripheral region; aperture oblique and angularly lunate in shape; peristome thin and slightly extended vertically upward; columellar region sub-oblique and somewhat thickened. Shell diameter 31.35 mm, height 10.53 mm.

Distribution: *O. shanensis* was hitherto known only from the type locality of Upper Salween (= Shan) River of Myanmar (= Burma).

Comparative remarks: The shell of *Oxytesta shanensis* (Godwin-Austen, 1883) is most similar to *O. cycloplax* (Benson, 1852) and *O. aborensis* Godwin-Austen, 1916, but is easily distinguished from them by its small size and body whorl less sharply keeled. It differs from *O. oxytes* (Benson, 1836) by its larger shell, less keeled body whorl, shallow spire, and wide umbilicus (Blanford and Godwin-Austen 1908; Godwin-Austen 1911, 1918; Mitra *et al.* 2005).

Discussion

The north-eastern region of Namdapha National Park constituting dense mixed wet evergreen forest, with altitude

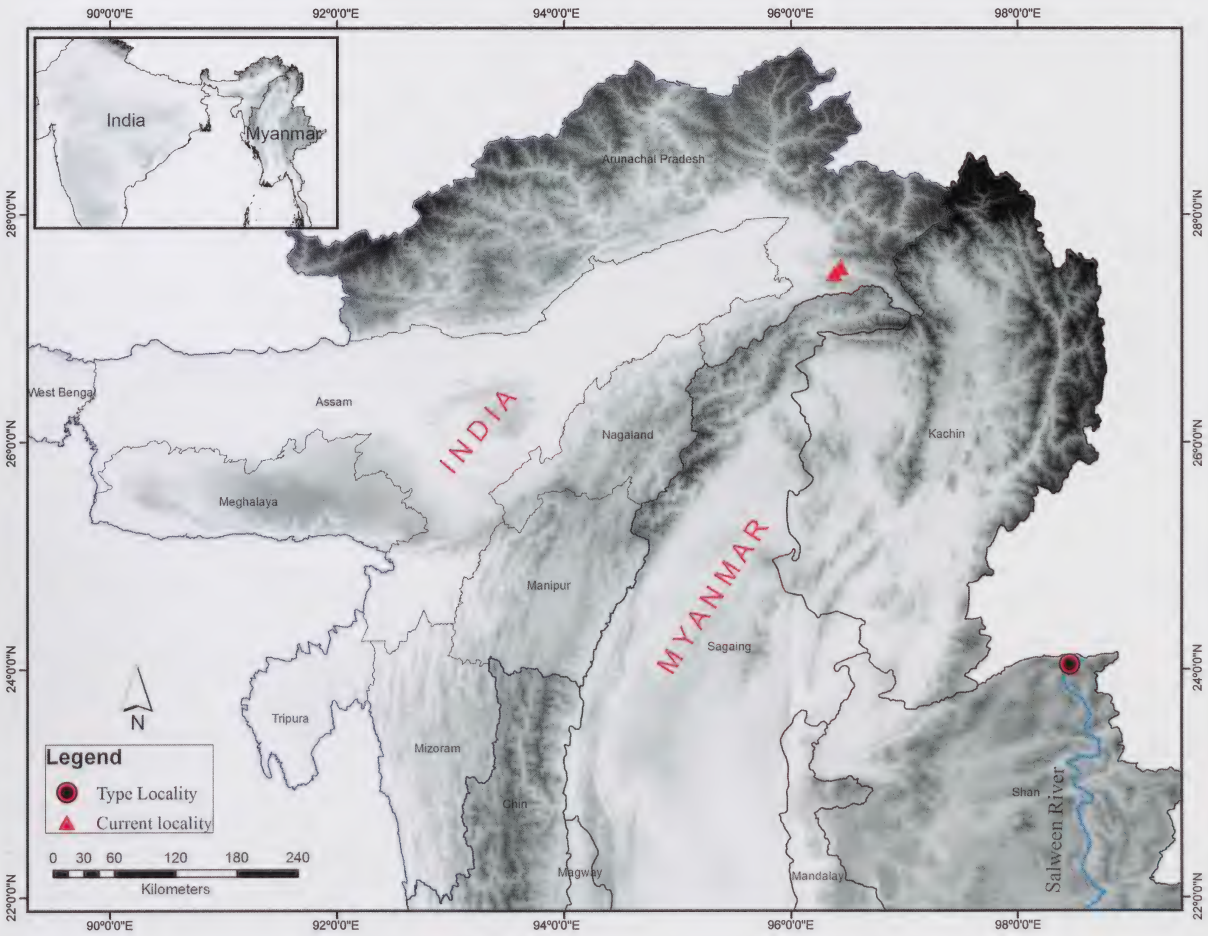

Fig. 2: Type locality (red and black circle) and current locality (red triangle) of *Oxytesta shanensis* (Godwin-Austen, 1883)

ranging from 500–1,500 m, is favourable for land snail habitats. During the current survey, 07 examples of *O. shanensis* were collected under leaf litter in the forest floor, 3 ex. from Hornbill and 4 ex. from Deban. The aerial distance between the current locality and the type locality (Fig. 2) of *O. shanensis* is approximately 435 km within the transitional zone of Himalayan and Indo-Burma Biodiversity Hotspot, therefore, species of this region have close resemblance with Myanmar fauna. Interestingly, there is a sympatric species of *Oxytesta aborensis* (Godwin-Austen, 1916) which has been reported from Arunachal Pradesh, India, sharing similar habitats.

There is some confusion on the occurrence of *O. shanensis* in India, as Ramakrishna *et al.* (2010) mentioned the presence of Godwin-Austen's *O. shanensis* in Balpakram National Park, West Garo Hills of Meghalaya, but without any specimen or confirmation on the species record being published (Subba Rao *et al.* 1995). Therefore, the present record of *O. shanensis* from Arunachal Pradesh in India is indeed a first record for the country.

ACKNOWLEDGEMENTS

We are grateful to the Director, Zoological Survey of India, Kolkata for providing necessary facilities and encouragement for preparing the manuscript. Thanks are due to National Mission on Himalayan Study (NMHS) Grant No: NMHSLG2016/0011/8509-8, dated 31st March, 2016, funded by the Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India. We acknowledge Arunachal Forest Department and Field Director, Namdapha Tiger Reserve, for providing the specimen collection permit and field work support. We are thankful to the Officer-in Charge and staff of Mollusca Section of Zoological Survey of India, for their help during the material examination. Thanks are due to Mr Arajush Payra and Mr Deepak C.K. of Biodiversity Project (NMHS-ZSI) for help during field survey and Mr Paromit Chatterjee for his kind assistance during the preparation of distributional map. We are also thankful to Amit, Taku, Ganesh, Ongda, and Pangda for their assistance during field survey.

REFERENCES

Blanford, W.T. & H.H. Godwin-Austen (1908): Fauna of British India. Mollusca (Testacellidae and Zonitidae). New Delhi, pp. 311.

Emberton, K.C., T.A. Pearce & R. Randalana (1996): Quantitatively sampling land-snail species richness in Madagascan rainforests. *Malacologia 38*: 203–212.

Godwin-Austen, H.H. (1883): Land and Freshwater Molluscs of India including South Arabia, Baluchistan, Afghanistan, Kashmir, Nepal, Burmah, Pegu, Tenasserim, Malay Peninsula, Ceylon, and other islands of the Indian Ocean, supplementary to Messrs. Theobald and Hanley's *Conchologia Indica 1(4)*: 128–129.

Godwin-Austen, H.H. (1911): Description of *Oxytes beddomei,* n. sp., from Upper Burma. *Journal of Molluscan Studies 9(5)*: 327–328.

Godwin-Austen, H.H. (1918): Mollusca, Macrochlamyinae (In Part). *Records of Indian Museum 8*: 581–600.

Mitra, S.C., A. Dey & Ramakrishna (2005): Pictorial Handbook – Indian Land Snails (Selected Species), Published by Zoological Survey of India, Kolkata, pp. 344.

Ramakrishna, S.C. Mitra & A. Dey (2010): Annotated checklist of Indian land molluscs. *Records of the Zoological Survey of India*, Occasional Paper *306*: 1–359.

Sajan, S.K., B. Tripathy & K. Sivakumar (2017): Sampling protocol for terrestrial molluscs in the high altitude landscape of the Indian Himalayas. *Scientific Transactions in Environment and Technovation 11(1)*: 54–57.

Subba Rao, N.V., S.C. Mitra, A. Dey & S. Maitra (1995): Molluscs of Meghalaya. *Fauna of Meghalaya, State Fauna Series, 4 (Part 8)*: 1–88. Published by The Director, Zoological Survey of India.

Zilch, A. (1956): Nomenklatorische Bemerkungen. *Archiv für Molluskenkunde 85(1/3)*: 85.

Recommended Citation

Sajan, S.K., Basudev Tripathy and Kailash Chandra (2019): New record of a land snail *Oxytesta shanensis* (Godwin-Austen, 1883) (Helicarionoidea: Ariophantidae) from India. *J. Bombay Nat. Hist.Soc. 116*: 140–142. doi: 10.17087/jbnhs/2019/v116/122331

34. FIRST RECORD OF *CHELIDONURA HIRUNDININA* (QUOY & GAIMARD, 1833) (MOLLUSCA: HETEROBRANCHIA: CEPHALASPIDEA) FROM LAKSHADWEEP ISLANDS, INDIA[1]

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[1]Accepted March 08, 2019
First published: May 31, 2019 | doi: 10.17087/jbnhs/2019/v116/139524
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Opisthobranchs, which are marine gastropod molluscs, possess fascinating colours and remarkable forms. Escalation in the number of studies pertaining to these sea slugs over the past decade in Lakshadweep Archipelago is reflected in the increasing number of species being frequently recorded from this region over the past few years (Apte 2009; Apte and Bhave 2014; Apte and Desai 2017; Apte and Salahuddin 2010; Apte *et al.* 2015; Chandran *et al.* 2017; Ravinesh *et al.* 2013). However, of the 400 species of sea slugs recorded so far from India (Apte and Desai 2017), only 103 species have been recorded from various islands of the Lakshadweep Archipelago (Chandran *et al.* 2017). This note reports the occurrence of the opisthobranch species *Chelidonura hirundinina* (Quoy & Gaimard, 1833) from Bangaram Island in the Lakshadweep Archipelago.

Chelidonura hirundinina, a small and colourful aglajid sea slug, was found during field studies in Bangaram (10° 56′ 44.92″ N, 72° 17′ 11.70″ E) on October 22, 2018, during low tide, when the intertidal region was completely exposed. This sand-dwelling species was collected and preserved in 90% ethyl alcohol after undertaking morphological studies. The specimens were deposited in the BNHS Faunal Collections Repository.

Phylum: Mollusca
Class: Gastropoda Cuvier, 1795
Subclass: Heterobranchia Burmeister, 1837
Order: Cephalaspidea Fischer, 1883
Superfamily: Philinoidea Gray, 1850
Family: Aglajidae Pilsbry, 1895
Genus: *Chelidonura* Adams, 1850
Species: *hirundinina* (Quoy & Gaimard, 1833)

Synonyms: *Bulla hirundinina* Quoy & Gaimard, 1833; *Chelidonura adamsi* Angas, 1867; *Chelidonura philinopsis* Eliot, 1903.

Material Examined: 6 ex., locality; Bangaram Island, Lakshadweep Archipelago, 22.x.2018, Coll: Sumantha Narayana, Deepak Apte and V.K. Salahudheen, Regn No. BNHS Opistho-1442.

Fig. 1: *Chelidonura hirundinina*

Size: 6–7 mm (Fig. 1), based on six specimens (BNHS Opistho-1442).

Description: Overall dark brown to black in colour with black and orange edging, yellow and blue lines on the body, vivid blue T-shaped mark on head, small white patch at posterior end of head shield, large white crescent-shaped mark on posterior shield.

Distribution: Eastern coast of Africa, Mauritius, La Réunion, tropical Indo-West Pacific and Caribbean Islands. In India, the species was previously reported only from Andaman and Nicobar Islands (Sreeraj *et al.* 2013).

ACKNOWLEDGEMENTS

We take this opportunity to acknowledge the financial support provided by MoEFCC, Government of India, under AICOPTAX-Mollusca. Dr J.R. Bhatt, Senior Advisor, MoEF&CC, is a constant source of encouragement. Dept of Environment and Forests, Lakshadweep Administration, has always been supportive.

REFERENCES

Apte, D.A. (2009): Opisthobranch fauna of Lakshadweep Islands, India with 52 new records to Lakshadweep and 40 new records to India. *J. Bombay Nat. Hist. Soc. 106(2)*: 162–175.

Apte, Deepak & Digant Desai (2017): Field Guide to the Sea Slugs of India. Bombay Natural History Society, Mumbai. xii + 459 pp.

Apte, D.A. & Vishal Bhave (2014): New records of Opisthobranchs from Lakshadweep, India (Mollusca: Heterobranchia). *Journal of Threatened Taxa 6(3)*: 5562–5568.

Apte, D.A. & V.K. Salahuddin (2010): Record of *Hexabranchus sanguineus* (Rüppell & Leuckart 1828) from Lakshadweep Archipelago, India. *J. Bombay Nat. Hist. Soc. 107(3)*: 261–262.

Apte, D., I. Babu & V.K. Salahuddin (2015): Three new records of Opisthobranchs (Mollusca) from Lakshadweep Islands, India. *J. Bombay Nat. Hist. Soc. 112(3)*: 183–185.

Chandran, B.K.S., R. Ravinesh & A.B. Kumar (2017): Additions to the sea snail fauna (Mollusca: Gastropoda: Opisthobranchia) of Lakshadweep Islands, India. *Journal of Threatened Taxa 9(12)*: 11045–11053.

Ravinesh, R., B.S. Chandran & A. Bijukumar (2013): Record of the dendrodorid slug, *Dendrodoris coronata* (Nudibranchia: Dendrodorididae) from Western Indian Ocean. *Mar. Biodivers. Rec. 6*: e116.

Sreeraj, C.R., C. Sivaperuman & C. Raghunathan (2013): Species Diversity and Abundance of Opisthobranch Molluscs (Gastropoda: Opisthobranchia) in the Coral Reef Environments of Andaman and Nicobar Islands, India. Pp. 81–106. *In*: (Eds: Venkataraman K., C. Sivaperuman & C. Raghunathan): Ecology and Conservation of Tropical Marine Faunal Communities. Springer, Berlin & Heidelberg.

Recommended Citation

Narayana, Sumantha, Deepak Apte and V.K. Salahuddin (2019): First record of *Chelidonura hirundinina* (Quoy & Gaimard, 1833) (Mollusca: Heterobranchia: Cephalaspidea) from Lakshadweep Islands, India. *J. Bombay Nat. Hist. Soc. 116:* 143–144. doi: 10.17087/jbnhs/2019/v116/139524

35. NEW RECORD OF *ENGINA PHASINOLA* (DUCLOS, 1840) (MOLLUSCA, GASTROPODA) FROM INDIA[1]

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[1]Accepted March 19, 2019
First published: July 31, 2019 | doi: 10.17087/jbnhs/2019/v116/140912

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Introduction

Franklin *et al.* (2015a) provided a comprehensive review of the studies carried out on phylum Mollusca in the Andaman Islands over a span of 135 years. However, the most comprehensive works on the molluscan fauna of Andaman and Nicobar Islands are by Subba Rao (2003) and Subba Rao and Dey (2000), who reported 1,282 species from these islands. Despite extensive studies, new finds of molluscs in the Andamans are not uncommon. For example, new species of Onchidiidae – *Melayonchis eloisae* and *Melayonchis aileenae* (Dayrat *et al.* 2017), a new species of *Haminoea – H. aptei* (Bharate *et al.* 2018), first record of *Titiscania limacina* (Apte and Mavlankar 2017), four new records of cones (Franklin *et al.* 2013), new record of *Natica arachnoidea* and *Ministrombus minimus* (Franklin *et al.* 2014), and three new records of tritons (Franklin *et al.* 2015b) were reported.

Material and methods

During surveys of the intertidal reef at Burmanallah, Port Blair (11° 34′ 29.57″ N, 92° 44′ 21.06″ E), South Andaman in the Andaman and Nicobar Islands, on March 29–30, and on April 02 and 06, 2018, I came across several live specimens of *Engina phasinola* (Fig. 1). Two live specimens were collected and preserved in ethyl alcohol and were deposited in the collections of the Bombay Natural History Society (under a single voucher number BNHS GASTRO-1399, collected on 30.iii.2018).

Results

Systematic accounts

Phylum: Mollusca Linnaeus, 1758
Class: Gastropoda Cuvier, 1795
Subclass: Caenogastropoda Cox, 1960
Order: Neogastropoda Wenz 1938
Superfamily: Buccinoidea Rafinesque, 1815
Family: Pisaniidae Gray, 1857
Genus: *Engina* Gray, 1839
Species: *phasinola* (Duclos, 1840)

Synonym: *Columbella phasinola* Duclos, 1840 (original combination)

Fig. 1: Live specimens of *Engina phasinola*

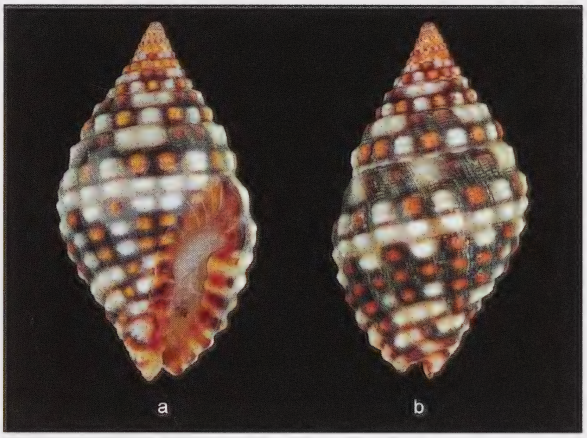

Fig. 2: *Engina phasinola* a) apertural view, b) abapertural view

Material examined: BNHS GASTRO-1399, Number of specimens: 2.

Shell measurements: Specimen 1: Height – 9.79 mm, Width – 5.11 mm

Specimen 2: Height – 8.7 mm, Width – 5.27 mm

Description

Shell small, solid and sculptured with nodulose spiral cords. A few of these cords bear alternately arranged paired nodules of white and deep brown orange colour. Aperture narrow, with strongly denticulate labial and columellar lips. Shell white with deep to light brown between the nodules. Nodulose spiral cords (10 on body whorl and two on each of the spiral whorls) have white and deep orange spots. Third (from top) of body whorl spiral cord on the body whorl has distinct white nodules connected with white band. An indistinct white band is also present at the base of the shell. Spire short but pointed, and nodular cords usually deep orange on the last few spiral whorls. Aperture deep orange brown with white lines at columellar region. Denticles white in colour. Outer lip with five distinct denticles, and one each near anterior and posterior siphonal canal. Inner lip has five to six denticles (Fig. 2 a, b).

Distribution: Uncommonly found across its distribution range; Indo-west Pacific: Taiwan, Japan, Australia, Fiji, and Vietnam. The species is uncommonly found in Andaman Islands.

Discussion

Family Pisaniidae, having 26 genera globally (MolluscaBase 2019), is relatively well-represented in India. With 21 species known till date from India, the family

Table 1: Species of genus *Engina* recorded from India

S. No	Species recorded from India	Distribution in India	Reference
1	*Engina alveolata* (Kiener, 1836)	Andaman, Nicobar, Lakshadweep, and Gujarat	Subba Rao & Dey 2000, Apte 2014
2	*Engina armillata* (Reeve, 1846)	Andaman, Nicobar, Andhra Pradesh, and Gujarat	Ramakrishna *et al.* 2007
3	*Engina lineata* (Reeve, 1846)	Andaman, Nicobar, Lakshadweep, and Tamil Nadu	Surya Rao & Subba Rao 1991, Apte 2014
4	*Engina mendicaria* (Linnaeus, 1758)	Andaman, Nicobar, Lakshadweep, and Tamil Nadu	Surya Rao & Subba Rao 1991
5	*Engina pulchra* (Reeve, 1846)	Andaman, Nicobar, Lakshadweep, Tamil Nadu, and Maharashtra	Dey 2016; Ravinesh & Biju Kumar 2015
6	*Engina trifasciata* (Reeve, 1846)	Lakshadweep, Gulf of Mannar (Tamil Nadu)	Namboodiri & Sivadas 1979; Hylleberg & Kilburn 2002
7	*Engina zea* Melvill, 1893	Goa, Maharashtra	Melvill 1893; Subrahmanyam *et al.* 1952
8	*Engina zonalis* (Lamarck, 1822)	Andaman, Nicobar, Lakshadweep, and Tamil Nadu	Hylleberg & Kilburn 2002
9	*Engina phasinola* (Duclos, 1840)	**Present find and New Record to India**	July 2019

comprises genus *Cantharus* (3 species), *Engina* (10 species excluding the current record), *Pisania* (1 species), *Pollia* (5 species), and *Clivipollia* [2 species, including a recent record by Apte (2018)]. Cernohorsky (1975) provided a detailed description of the genus *Engina*. The species of genus *Engina* recorded from India are listed (Table 1). However, *E. rawsoni* Melvill, 1897 has been re-assigned to a different genus as *Pollia rawsoni* (Melvill, 1897). Further, Namboodiri and Sivadas (1979) recorded two species of *Engina* from Lakshadweep; identity of both is doubtful. In the paper there is a reference to *E. zonata* Reeve, but there is no such species that can be attributed to Reeve. Thus, these two species are not included in Table 1. Similarly, *E. trifasciata* (Reeve, 1846) as stated by Namboodiri and Sivadas (1979) could not be ascertained in the absence of an image or voucher specimens, and may be a misidentification. However, *E. trifasciata* has been reported from Gulf of Mannar (Hylleberg and Kilburn 2002). The checklist of molluscs from Lakshadweep by Ravinesh and Biju Kumar (2015) includes *Engina turbinella* (Kiener, 1836), citing the reference of Namboodiri and Sivadas (1979). However, this is a synonymized name for *Engina zonata* Gray, 1839 and not *Engina zonata* Reeve as stated in Namboodiri and Sivadas (1979). *E. turbinella* is only known from North and South America, Atlantic Ocean, Caribbean Sea and Gulf of Mexico, and its presence in India is not known. Considering the re-designation of *E. rawsoni* Melvill, 1897 to another genus and invalid record of *Engina zonata* Reeve, the total count of species under genus *Engina* in India is eight (8).

The current find of *Engina phasinola* is thus an important addition to the molluscan fauna of India. It extends its range to India, taking the count of total number of species under the genus *Engina* to nine (9).

ACKNOWLEDGEMENTS

I appreciate and acknowledge the Ministry of Environment, Forest and Climate Change for financial support under All India Co-ordinated Project on Taxonomy (AICOPTAX). I wish to thank Ms Monisha Bharate and Dr Vishal Bhave for their help during the preparation of plates and Dr Sumantha Narayana during the field work. I am also grateful to Department of Forests and Environment, Andaman and Nicobar Islands, for all the help provided.

REFERENCES

Apte, D.A. (2014): Sea Shells of India: An Illustrated Guide to Common Gastropods. BNHS and Oxford University Press. 225 pp.

Apte, D.A. (2018): A new record of *Clivipollia fragaria* (W. Wood, 1828) (Gastropoda: Buccinoidea: Pisaniidae) from India. *J. Bombay Nat. Hist. Soc. 115*: 52–53. doi: 10.17087/jbnhs/2018/v115/121551.

Apte, D.A. & S. Mavlankar (2017): First record of *Titiscania limacina* Bergh, 1890 (Mollusca: Gastropoda) from India. *J. Bombay Nat. History Soc.112(3)*: 22–25. doi: 10.17087/jbnhs/2015/v112i3/114438.

Bharate, M., T.R. Oskars, S. Narayana, R. Ravinesh, A. Biju Kumar & M.A.E. Malaquias (2018): Description of a new species of *Haminoea* (Gastropoda: Cephalaspidea) from India, with an account of the diversity of the genus in the Indo-West Pacific. *Journal of Natural History 52(37–38)*: 2437–2456. doi: 10.1080/00222933.2018.1533598.

Cernohorsky, W.O. (1975): Supplementary notes on the taxonomy of Buccinid species of the subfamily Pisaniinae (Mollusca: Gastropoda). *Records of the Auckland Institute and Museum 12*: 175–211.

Dayrat, B., T. Goulding, D. Apte, V. Bhave & Xuân Quang Ngô (2017): A new genus and four new species of onchidiid slugs from South-East Asia (Mollusca: Gastropoda: Pulmonata: Onchidiidae). *Journal of Natural History 51(31–32)*: 1851–1897. doi: 10.1080/00222933.2017.1347297.

Dey, A. (2016): Catalogue of marine molluscs (Polyplacophora and Gastropoda). *Zoological Survey of India*, Kolkata. 687 pp. + 192 pl.

Franklin, J.B., N.V. Vinithkumar & R. Kirubagaran (2015a): Discovery of marine molluscs from the Andaman and Nicobar Islands: past, present and prospects. *Journal of the Andaman Science Association 20(1)*: 27–35.

Franklin, J.B., P. Venkateshwaran, N.V. Vinithkumar & R. Kirubagaran (2015b): First record of three tritons (Gastropoda: Tonnoidea: Ranellidae) from the Andaman Islands, India. *J. Mar. Biol. Ass. India 57(1)*: 47–51. doi: 10.6024/jmbai.2015.57.1.01822-07.

Franklin, J.B., N.V. Vinithkumar & R. Kirubagaran (2014): Two new records of marine gastropods from Andaman and Nicobar Islands, India. *Marine Biodiversity Records 7(41)*: 1–5.

Franklin, J.B., P. Venkateshwaran, N.V. Vinithkumar & R. Kirubagaran (2013): Four new records of family Conidae (Caenogastropoda: Mollusca) from Andaman Islands. *Zootaxa 3635(1)*: 81–86.

Hylleberg, J. & R.N. Kilburn (2002): Annotated inventory of molluscs from the Gulf of Mannar and vicinity. *Phuket Marine Biological Center Special Publication 26*: 19–79.

Melvill, J.C. (1893): Descriptions of twenty-five new species of marine shells from Bombay collected by Mr. Alexander Abercrombie. *J. Bombay Nat. Hist. Soc. 8*: 234–245.

Melvill, J.C. (1897): Descriptions of thirty four species of marine Mollusca from the Arabian Sea, Persian Gulf and Gulf of Oman (mostly collected by F.W. Townsend Esq.). *Mem. Proc. Manch. Lit. Philos. Soc. 41(7)*: 1–26.

MolluscaBase (2018): Pisaniidae Gray, 1857. Accessed at: http://molluscabase.org/aphia.php?p=taxdetails&id=1054108 on August 06, 2019.

Namboodiri, P.N. & P. Sivadas (1979): Zonation of molluscan assemblage at Kavaratti Atoll (Laccadives). *Mahasagar 12(2)*: 239–246.

Ramakrishna, A.D., S. Barua & A. Mukhopadhya (2007): Fauna of Andhra Pradesh, State Fauna Series, 5(Part-7) Marine Molluscs. Pp. 260. Published by the Director, Zool. Surv. India, Kolkata.

RAVINESH, R. & A. BIJU KUMAR (2015): A checklist of the marine molluscs of Lakshadweep, India. *Journal of Aquatic Biology & Fisheries 3*: 15–55.

SUBBA RAO, N.V. (2003): Indian Seashells (Part-I): Polyplacopora and Gastropoda. *Rec. Zool. Surv. India,* Occ. Paper No. 192 (i–x): 1–416.

SUBBA RAO, N.V. & A. DEY (2000): Catalogue of Marine Molluscs of Andaman and Nicobar Islands. *Rec. Zool. Surv. India, Occ. Paper No.* 187 (i–x): 1–323.

SUBRAHMANYAM, T.V., K.R. KARANDIKAR & N.N. MURTI (1952): Marine gastropoda of Bombay. *J. Univ. Bombay B 20*: 21–34.

SURYA RAO, K.V. & N.V. SUBBA RAO (1991): Mollusca. *In*: Ghosh, A.K. & A. Kumar (Eds): State Fauna Series 2, Fauna of Lakshadweep. Zool. Surv. India, Kolkata. Pp. 273–362.

Recommended Citation

Apte, Deepak (2019): New record of *Engina phasinola* (Duclos, 1840) (Mollusca, Gastropoda) from India. *J. Bombay Nat. Hist. Soc. 116*: 144–147. doi: 10.17087/jbnhs/2019/v116/140912

36. A NEW RECORD OF *QUASIMITRA CARDINALIS* (GMELIN, 1791) (MOLLUSCA: GASTROPODA) FROM THE LAKSHADWEEP ISLANDS, INDIA[1]

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[1]Accepted January 11, 2019
First published: September 30, 2019 | doi: 10.17087/jbnhs/2019/v116/121554
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Introduction

Lakshadweep, on the west coast of India, is a small union territory comprising 36 islands with a total lagoon area of 4,200 sq. km. Among invertebrates, marine molluscan fauna has been well-studied in the Lakshadweep Islands. The most recent checklist published by Ravinesh and Biju Kumar (2015) includes 768 species classified under 4 classes, 37 orders, 72 superfamilies, 140 families, and 377 genera. Among these, family Mitridae is represented by 24 species. The present finding is a part of our ongoing work in the Lakshadweep Islands under the All India Co-ordinated Project on Taxonomy (AICOPTAX) – Mollusca programme.

Material and methods

During a survey of intertidal reefs at Kavaratti (10° 32′ 51.17″ N; 72° 37′ 29.08″ E) on January 29, 2018, I came across two dead specimens of *Quasimitra cardinalis* (Gmelin, 1791). Morphological measurements such as the shell length and shell width were recorded to the nearest millimetre. Specimens were deposited in the collection of the Bombay Natural History Society (BNHS GASTRO-1071).

Results

Systematic account

Phylum: Mollusca Linnaeus, 1758

Class: Gastropoda Cuvier, 1795

Subclass: Caenogastropoda

Order: Neogastropoda

Superfamily: Mitroidea Swainson, 1831

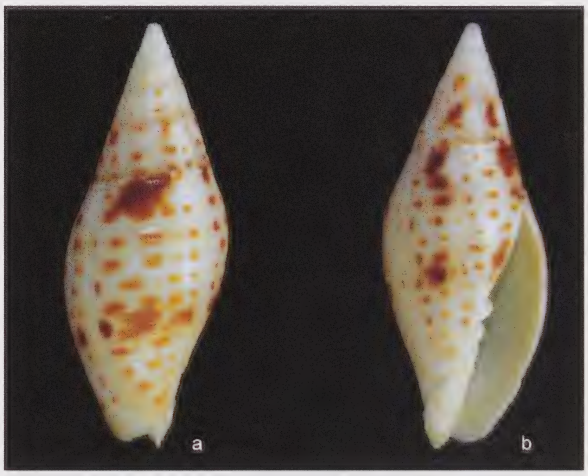

Fig. 1: *Quasimitra cardinalis* (Gmelin, 1791): a) Abapertural view; b) Apertural view

Family: Mitridae Swainson, 1831

Subfamily Mitrinae Swainson, 1831

Genus: *Quasimitra* Fedosov, Herrmann, Kantor & Bouchet, 2018

Species: *cardinalis*

Synonyms: *Voluta pertusa* Born, 1780 (non Linnaeus, 1758) [unaccepted]; *Voluta cardinalis* Gronovius, 1781; *Voluta cardinalis* Gmelin, 1791 (original combination); *Mitra cardinalis* (Gmelin, 1791); *Mitra* (*Mitra*) *cardinalis* (Gmelin, 1791) accepted, alternate representation; *Mitra vermiculosa*

Martyn, 1784; *Mitra monachialis* Röding, 1798; *Mitra archiepiscopalis* Lamarck, 1811; *Mitra cardinalis* Lamarck, 1811; *Mitra pertusa* Swainson, 1822; *Mitra lamarckii* Deshayes, 1838 (non Deshayes, 1832) [unaccepted]; *Mitra vermiculata* Dall, 1905.

Material examined

Number of specimens: 2.

Shell measurement: Length 38 mm and 33 mm; Width 15 mm and 12 mm.

Collection locations: Intertidal area on the eastern lagoon at Kavaratti Island, Lakshadweep Archipelago, India.

Distribution: Widely distributed from Madagascar to Polynesia (Cernohorsky 1976). It is also reported from the Andaman and Nicobar Islands, India (Dey 2016; Subba Rao 2003; Subba Rao and Dey 2000).

Description

The shell is solid and ovate, white in colour, having rows of dark brown to light orange spots. A few dark brown blotches are seen. The shell has punctated spiral grooves and axial striae. Columella has 4–5 oblique folds. Outer lip near the anterior siphonal canal has a few tiny spinal projections (Figs 1a, b).

Conclusion

In all, the Family Mitridae is well-represented in India. Subba Rao and Dey (1984) undertook a thorough review of family Mitridae from India and reported 45 species. Subba Rao (2003) reiterates the known species count as being 45. Dey (2016) reported 59 species that are found in India, of which three were found to be doubtful. Surya Rao and Subba Rao (1991) reported 15 species belonging to Mitridae from Lakshadweep Islands. Ravinesh and Biju Kumar (2015) reported 24 species. Our thorough literature review, however, revealed the presence of 61 species along the Indian coast (Apte 2019). Fedosov *et al.* (2018) recently reorganized family Mitridae based on integrative taxonomy that included erection of a separate family Charitodoronidae and established 11 new genera: *Quasimitra*, *Roseomitra*, *Fusidomiporta*, *Profundimitra*, *Cancillopsis*, *Pseudonebularia*, *Gemmulimitra*, and *Neotiara* in Mitrinae; *Imbricariopsis* in Imbricariinae; *Carinomitra* and *Condylomitra* have been left unassigned to a subfamily. Nominal genera such as *Dibaphus*, *Mitroidea*, and *Mutyca* are now synonyms of Genus *Nebularia*. Including the current record of *Quasimitra cardinalis* and the recent record of *Nebularia ustulata* (Apte 2019), the total species count of family Mitridae from Lakshadweep Islands is increased to 26.

REFERENCES

Apte, D.A. (2019): First record of *Nebularia ustulata* (Reeve, 1844) from India. *J. Bombay Nat. Hist. Soc. 116*: 138–139. doi: 10.17087/jbnhs/2019/v116/122744

Cernohorsky, W.O. (1976): The Mitridae of the World. Pt 1. The subfamily Mitrinae. *Indo-Pacific Mollusca 3(17)*: 273–528.

Dey, A. (2016): Catalogue of Marine Molluscs (Polyplacophora and Gastropoda). Zoological Survey of India, Kolkata. 687 pp. + 192 pl.

Fedosov, Alexander, Nicolas Puillandre, Manfred Herrmann, Yuri Kantor, Marco Oliverio, Polina Dgebuadze, Maria Vittoria Modica & Philippe Bouchet (2018): The collapse of *Mitra*: molecular systematics and morphology of the Mitridae (Gastropoda: Neogastropoda). *Zoological Journal of the Linnaean Society XX*: 1–85, 43 figures. https://doi.org/10.1093/zoolinnean/zlx073.

Ravinesh, R. & A. Biju Kumar (2015): A checklist of the marine molluscs of Lakshadweep, India. *Journal of Aquatic Biology & Fisheries 3*: 15–55.

Subba Rao, N.V. (2003): Indian Seashells (Part I): Polyplacophora and Gastropoda. *Rec. Zool. Surv. India,* Occ. Paper No. 19 (i–x): 1–416.

Subba Rao, N.V. & A. Dey (1984): Contribution to the knowledge of Indian marine molluscs. I. Family Mitridae. *Rec. Zool. Surv. India*, Occ. Paper No. 61, 48 pp.

Subba Rao, N.V. & A. Dey (2000): Catalogue of Marine Molluscs of Andaman and Nicobar Islands. *Rec. Zool. Surv. India,* Occ. Paper No. 187, x + 323 pp.

Surya Rao, K.V. & N.V. Subba Rao (1991): Mollusca. Pp. 273–362. *In*: State Fauna Series 2, Fauna of Lakshadweep. Zoological Survey of India, Kolkata. 413 pp.

Recommended Citation

Apte, Deepak (2019): A new record of *Quasimitra cardinalis* (Gmelin, 1791) (Mollusca: Gastropoda) from the Lakshadweep Islands, India. *J. Bombay Nat. Hist. Soc. 116*: 147–148. doi: 10.17087/jbnhs/2019/v116/121554

37. RANGE EXTENSION OF THREE HETEROBRANCH MOLLUSCANS IN GUJARAT, WESTERN INDIA[1]

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[1]Accepted June 11, 2019
First published: September 30, 2019 | doi: 10.17087/jbnhs/2019/v116/143947
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Introduction

Heterobranchs are among the least studied molluscs in India, and the work done on heterobranch fauna is sparse and patchy. The earliest work dates back to the 1880s, by Alder and Hancock (1864). Studies on the heterobranch fauna of Gulf of Kachchh are limited to a few publications by Burn (1970), Eliot (1909), Gideon *et al.* (1957), Menon *et al.* (1961), Narayanan (1969, 1970, 1971a,b), Rudman (1980), Apte *et al.* (2010), Patel *et al.* (2013), Patel and Apte (2014), Parasharya and Patel (2014), Parasharya *et al.* (2014), Prasade *et al.* (2013), and Prasade *et al.* (2015). Other notable historical works on Indian Heterobranchia are by Hornell (1909, 1949, 1951) and O'Donoghue (1932). In recent times, Apte *et al.* (2010), Bhave and Apte (2011), Raghunathan *et al.* (2010), and Sreeraj *et al.* (2010) are notable works on heterobranch fauna of India. Apte and

Fig. 1: Study sites

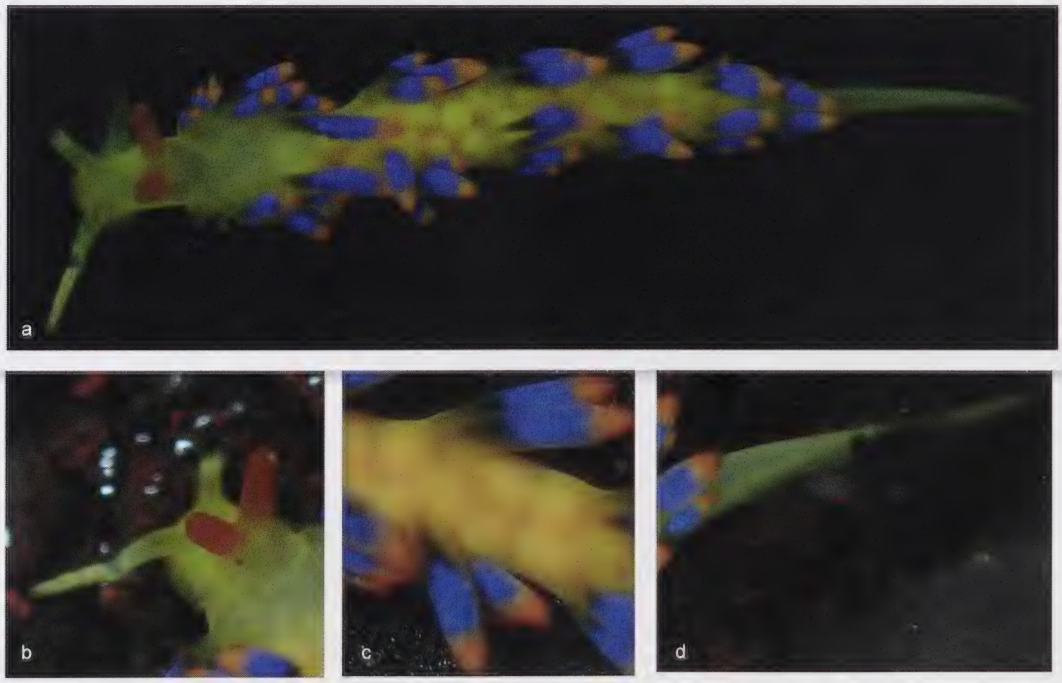

Fig. 2: *Trinchesia ornata* (Baba, 1937): a) Dorsal view, b) Rhinophore, c) Cerata, d) Tail

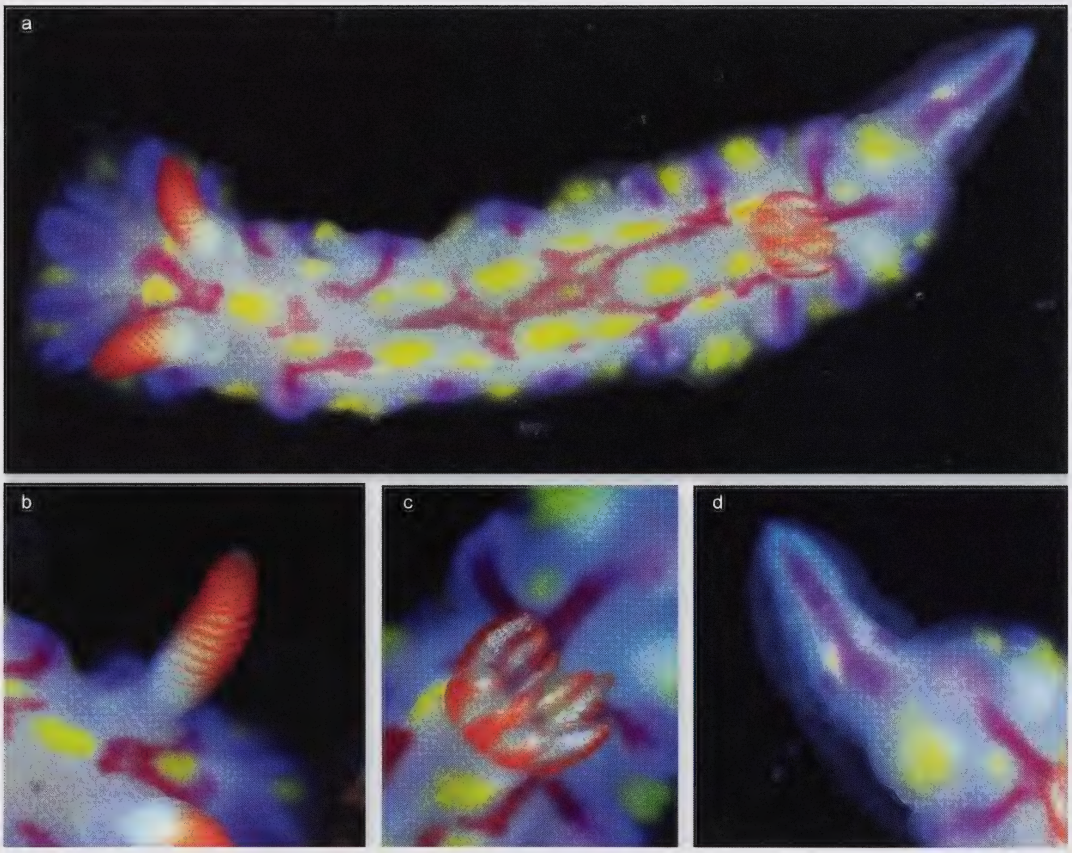

Fig. 3: *Hypselodoris zebrina* (Alder & Hancock, 1864)
a) Dorsal view, b) Rhinophore, c) Gills, d) Tail

Desai (2017) published a field guide illustrating more than 300 species of heterobranch fauna of India.

Study sites

The current study was carried out in coastal locations of Gujarat in western India. Poshitra Reef (22° 24′ 6.60″ N; 69° 12′ 3.56″ E) (Fig. 1) is located in the Gulf of Kachchh; the habitat predominantly bears live corals and sandy muddy deposits. Another site, Aadri coast (20° 57′ 35.43″ N; 70° 16′ 41.00″ E) (Fig. 1) is located along the Saurashtra coast; here the habitat is dominated by rocky substratum, dotted with small rocky pools.

Material and methods

Live specimens were collected by direct sighting method (Apte 2009; Apte *et al.* 2010) from the intertidal areas of Poshitra Reef and Aadri coast of Gujarat State. The specimens collected were photo-documented live whenever possible, and preserved in 90% ethyl alcohol for further taxonomic studies. The heterobranchs were identified with key references such as Alder and Hancock (1864), Gosliner *et al.* (2008), and Apte and Desai (2017). All the voucher specimens were deposited in the collections of the BNHS with accession numbers *Trinchesia ornata* (GJ01R2221118A), *Hypselodoris zebrina* (GJ05BD231118A), and *Eubranchus mandapamensis* (GJ01D1190219F). Recent systematics were followed for classification (Jörger *et al.* 2010).

Family:Trinchesiidae Ihering, 1879

Species: ***Trinchesia ornata*** (Baba, 1937) [Fig. 2]

Synonyms: *Cuthona ornata* Baba, 1937, *Catriona ornata* (Baba 1937), *Tenellia ornata* (Baba 1937).

Distribution: INDIA: Ratnagiri (Apte and Desai 2017); EXTRALIMITAL: Indo-west, central and eastern Pacific, Japan (Baba 1937), Hong Kong, Korea (Gosliner *et al.* 2008), Guam (Carlson and Hoff 2003), Thailand (Mehrotra and Scott 2016), Tanzania (Gosliner *et al.* 2008).

Identification: Body yellow to orange. Cerata, oral tentacles, and proximal parts of the rhinophores white with blue pigmentation in basal part.

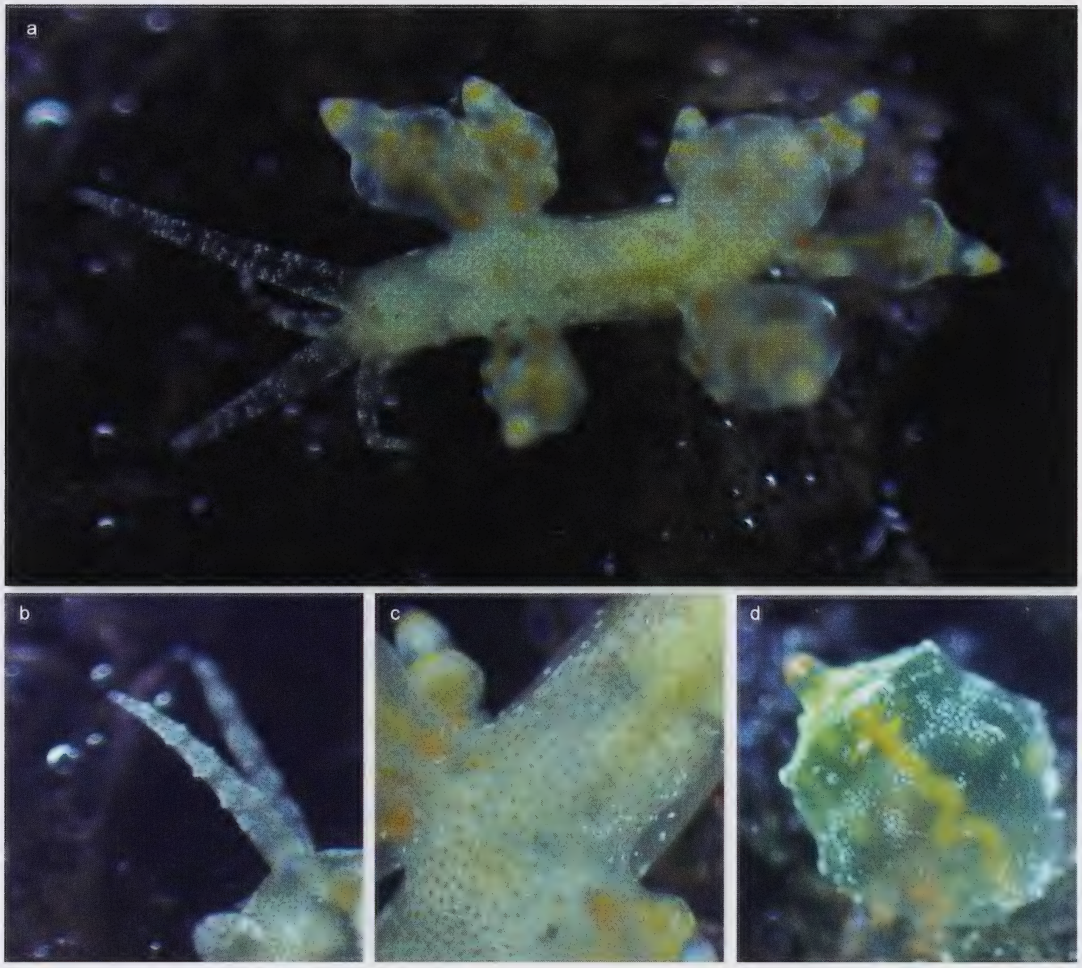

Fig. 4: *Eubranchus mandapamensis* (K.P. Rao, 1968)
a) Dorsal view, b) Rhinophores, c) Body pattern, d) Cerata

Material Examined: Single specimen.

Size: 8 mm.

Habit: Occurs on various substrates at 2–20 m depth. Abundant on bryozoan colonies of *Microporina articulata* (Chichvarkhin 2016).

Family: Chromodorididae Bergh, 1891

Species: ***Hypselodoris zebrina*** (Alder & Hancock, 1864) [Fig. 3]

Synonym: *Chromodoris zebrina* Alder & Hancock, 1864

Material Examined: Single specimen. **Size**: 10 mm.

Distribution: INDIA: Andhra Pradesh (Alder and Hancock, 1864), Andaman and Nicobar Islands (Ramakrishna *et al.* 2010; Venkataraman *et al.* 2015), Kerala (Sneha Chandran *et al.* 2017).

EXTRALIMITAL: Thailand, Malaysia (Domínguez *et al.* 2007; Gosliner *et al.* 2015; Rudman 2002)

Identification: Body white with purplish margin. Numerous transverse semi-developed purple lines, suggesting that the specimen may be juvenile (compared to the well-connected purple lines observed in the adult). Numerous yellow spots present on the body and also between the transverse purple lines as well as near the mantle edge. Rhinophores perfoliate, lamellae white with red outlines. Nine gills, white in colour with orange-red outline, were observed. Well-defined tail with purple middle line and white border.

Family: Eubranchidae Odhner, 1934

Species: ***Eubranchus mandapamensis*** (K.P. Rao, 1968) [Fig. 4]

Synonym: *Annulorhina mandapamensis* K.P. Rao, 1968

Distribution INDIA: Tamil Nadu (Rao, 1968); Ratnagiri (Bhave and Apte 2011)

EXTRALIMITAL: Indo-Pacific, Hawai, Mexico

Identification: The observed specimen had a translucent body with minute brownish spots. Rhinophores annulated (Fig. 4b) with six annuli. Cerata broad and inflated at the central part, with yellow band at the top and two tiers of tubercles and a bulbous tip. Second pair of cerata large, with yellow digestive gland. Bright orangish yellow band present on the sub-apical region of the cerata, followed by pink or purple band just below the sub-apical region.

Material Examined: 2 specimens. **Size**: 11 mm (specimen 1), 8 mm (specimen 2).

These records help to bridge the gaps in the known distribution of Indian heterobranchs, thus strengthening species inventory, which is very important. Also Poshitra, one of the study sites, is part of a marine protected area, the Marine National Park, Gujarat, and harbours pristine coral reefs, hence the records are noteworthy for the conservation of these critical ecosystems.

REFERENCES

Alder, J. & A. Hancock (1864): Notice on the collection of Nudibranchiate mollusca made in India by Walter Eliot Esq. with descriptions of several new genera and species. *Trans. Zool. Soc. Lond. 5*: 117–147.

Apte, D.A. (2009): Heterobranch fauna of Lakshadweep Islands, India with 52 new records to Lakshadweep and 40 new records to India. *J. Bombay Nat. Hist. Soc. 106(2)*: 162–175.

Apte, D. & D. Desai (2017): Field Guide to the Sea Slugs of India. Bombay Natural History Society, Mumbai, pp xii + 459.

Apte, D.A., V. Bhave & D. Parasharya (2010): An annotated and illustrated checklist of the heterobranch fauna of Gulf of Kutch, Gujarat, India with 21 new records for Gujarat and 13 new records for India: Part 1. *J. Bombay Nat. Hist. Soc. 107(1)*: 14–23.

Baba, K. (1937): Heterobranchia of Japan (II). *J. Dept of Agri. 5*: 289–344. Kyushu Imperial University.

Bhave, V. & D. Apte (2011): Illustrated checklist of heterobranch fauna of Ratnagiri, Maharashtra, India, with eight new records to India. *J. Bombay Nat. Hist. Soc. 108(3)*: 172–182.

Burn, R. (1970): *Phyllidia (Phyllidiella) zeylanica* Kelaart, a rare nudibranch from the Indian subcontinent. *Memoirs of the National Museum of Victoria 31*: 37–40.

Carlson, Clay & Hoff, Patty Jo (2003): The Heterobranchs of the Mariana Islands. *Micronesica 3536*: 271–293.

Domínguez, M., P. Quintas & Js. Troncoso (2007): Phyllidiidae (Heterobranchia: Nudibranchia) from Papua New Guinea with the description of a new species of *Phyllidiella*. *Am. Malacol. Bull. 22*: 89–117.

Eliot, C.N.E. (1909): Report on the nudibranchs collected by Mr. James Hornell at Okhamandal in Kattiawar in 1905–1906. *In*: Report to the Government of Baroda on the marine zoology of Okhamandal. 1: 137–145.

Gideon, P.W., P.K.B. Menon, S.R.V. Rao & K.V. Jose (1957): On the marine fauna of the Gulf of Kutch: A preliminary survey. *J. Bombay Nat. Hist. Soc. 54(3)*: 690–706.

Gosliner, T.M., A. Valdés & D.W. Behrens (2015): Nudibranch and Sea Slug Identification – Indo-Pacific. New World Publications, Jacksonville, Florida, 408 pp.

Gosliner, T.W., D.W. Behrens & A. Valdés (2008): Indo-Pacific nudibranchs and sea slugs: a field guide to the world's most diverse fauna. Sea Challengers Natural History Books, Washington, 425 pp.

Hornell, J. (1909): A note on the presence of symbiotic algae in the integuments of nudibranchs of the genus *Melibe*. *In:* Report to the Government of Baroda on the marine zoology of Okhamandal. 1: 145–148.

Hornell, J. (1949): The study of Indian molluscs (Part II). *J. Bombay Nat. Hist. Soc. 48(3)*: 543–569.

Hornell, J. (1951): Nudibranchia. *In*: Indian molluscs. Bombay Natural History Society. Pp. 41–42 (pl 1).

Jörger, Katharina M., Isabella Stöger, Yasunori Kano, Hiroshi Fukuda, T. Knebelsberger & M. Schrödl (2010): On the origin of Acochlidia and other enigmatic euthyneuran gastropods, with implications for the systematics of Heterobranchia. *BMC Evolutionary Biology 10*: 323.

Mehrotra, R. & C. Scott (2016): Species inventory of sea slugs (Gastropoda: Heterobranchia) for Koh Tao, Thailand, with 25 first records for Thai waters. *Marine Biodiversity 46*: 761–771. doi: 10.1007/s12526-015-0424-7.

Menon, P.K.B., A.K. Datta Gupta & D. Das Gupta (1961): On the marine fauna of the Gulf of Kutch. *J. Bombay Nat. Hist. Soc. 58(2)*: 475–494, pls 1–10.

Narayanan, K.R. (1969): On the heterobranchiate fauna of the Gulf of Kutch. Proceedings of the Symposium on Mollusca held at Cochin from January 12 to 16, 1968, Symposium Series 3, pt 1, pp. 189–213; figs 1–20. Marine Biological Association of India, Mandapam Camp, India.

Narayanan, K.R. (1970): On a species of the genus *Berthellina* (Heterobranchia: Notaspidea) of the Gulf of Kutch. *Journal of the Marine Biological Association of India 12*: 210–213.

Narayanan, K.R. (1971a): On two doridacean nudibranchs (Mollusca: Gastropoda), from the Gulf of Kutch, new to the Indian coast. *J. Bombay Nat. Hist. Soc. 68(1)*: 280–281.

Narayanan, K.R. (1971b): On a species of the genus *Berthellina* (Heterobranchia: Notaspidea) of the Gulf of Kutch. *J. Mar. Biol. Ass. India 12(1–2)*: 210–212; tbl. 1.

O'donoghue, C.H. (1932): Notes on Nudibranchiata from southern India. *Proceedings of the Malacological Society of London 20*: 141–166.

Parasharya, D. & B. Patel (2014): Spawning aggregation of *Melibe viridis* Kelaart (1858) from Gulf of Kachchh – Western India. *IJSRP 4(3)*: 1–5.

Parasharya, D., B. Patel & H. Salvi (2014): Further records to the heterobranch fauna of India. *Cibtech Journal of Zoology 3(1)*: 19–26.

Patel, B. & D. Apte (2014): Recent record of *Mexichromis mariei* (Crosse, 1872) from Gulf of Kachchh, Gujarat, India. *European Journal of Zoo. Res. 3(1)*: 9–12.

Patel, B., M. Shukla & D. Apte (2013): First record of *Dendrodoris nigra* (Stimpson, 1855) from the Saurashtra coast of Gujarat with observation on effect of sediment composition on distribution. *Research Journal of Mar. Sci. 1(3)*:10–14.

Prasade, A., V. Bhave, B. Patel & D. Apte (2013): First record of *Thordisa villosa* (Heterobranchia: Nudibranchia: Discodorididae) from the west coast of India. Marine Biodiversity Records, Marine Biological Association of the United Kingdom, Vol. 6.

Prasade, A., B. Patel, R. Salunkhe, V. Bhave & D. Apte (2015): A first record of *Taringa caudata* (Farran, 1905) (Nudibranchia:

Discodorididae) from India. *JoTT 7(10)*: 7706–7709.

Raghunathan, C., C. Sivaperuman & Ramakrishna (2010): An account of newly recorded five species of nudibranch (Opisthobranchia, Gastropoda) in Andaman and Nicobar Islands. Pp. 283–288. *In*: Recent trends in biodiversity of Andaman and Nicobar Islands. Z.S.I., Kolkata.

Ramakrishna, C.R. Sreeraj, C. Raghunathan, C. Sivaperuman, J. Yogeshkumar, R. Raghuraman, Titus Immanuel & P.T. Rajan (2010): Guide to Heterobranchs of Andaman and Nicobar Islands Published by the Director, Zoological Survey of India, Kolkata, pp. 198.

Rao, K.P. (1968): On a new genus and some new species of heterobranchiate gastropods of the family Eubranchidae from the Gulf of Mannar. Proceedings of the Symposium on Mollusca held at Cochin. Part 1: 51–60.

Rudman, W.B. (1980): Aeolid heterobranch molluscs (Glaucidae) from the Indian Ocean and the south-west Pacific. *Zoological Journal of the Linnaean Society 68*: 139–172.

Rudman, W.B. (2002): *Hypselodoris zebrina* (Alder & Hancock, 1864). *In*: Sea Slug Forum. Australian Museum, Sydney. Available from http://www.seaslugforum.net/factsheet/hypszebri

Sneha Chandran, B.K., S. Shrinivaasu, R. Ravinesh, P. Robert, A.B. Aneesha & A. Biju Kumar (2017): Heterobranch (Mollusca: Gastropoda) fauna of Kerala, India: A citizen science initiative. *Journal of the Marine Biological Association, India 59(1)*: 49–57.

Sreeraj, C.R., P.T. Rajan, R. Raghuraman, C. Raghunathan, R. Rajkumar, T. Immanuel & Ramakrishna (2010): On some new records of sea slugs (Class: Gastropoda, Subclass: Heterobranchia) from Andaman and Nicobar Islands. *In*: Recent Trends in Biodiversity of Andaman and Nicobar Islands. ZSI, Kolkata, pp. 289–298.

Venkataraman, K., C. Raghunathan, R. Raghuraman & S. Dixit (2015): Fascinating Sea Slugs and Flatworms of Indian Seas. Zoological Survey of India, Kolkata, 149 pp.

Recommended Citation

Patel, Bhavik, Dishant Parasharya and Deepak Apte (2019): Range extension of three heterobranch molluscans in Gujarat, Western India *J. Bombay Nat. Hist. Soc. 116*: 149–153. doi: 10.17087/jbnhs/2019/v116/143947

38. FIRST RECORD OF *COLUBRARIA NITIDULA* (SOWERBY I, 1833) (MOLLUSCA: GASTROPODA) FROM LAKSHADWEEP ISLANDS, INDIA[1]

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[1]Accepted February 12, 2019
First published: October 31, 2019 | doi: 10.17087/jbnhs/2019/v116/121555
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Introduction

Family Colubrariidae comprises seven genera, namely *Bartschia* Rehder 1943; *Colubraria* Schumacher 1817; *Cumia* Bivona-Bernardi 1838; *Iredalula* Finlay 1926; *Kanamarua* Kuroda 1951; *Metula* H. Adams & A. Adams 1853, and *Minibraria* Sarasúa, 1984. Of these, only *Colubraria* and *Metula* are represented in the molluscan fauna of India (Table 1).

Material and methods

Under the All India Co-ordinated Project on Taxonomy (AICOPTAX) – Mollusca programme, molluscan faunal studies are currently being carried out across the Lakshadweep archipelago. During a survey of the inter-tidal reef at Kavaratti (10° 32′ 51.17″ N; 72° 37′ 29.08″ E) on January 29, 2018, I came across more than a hundred specimens of *Colubraria nitidula* on the eastern reef, within a stretch of 800 m in shallow water of 0.5 m depth during low tide. Ten dead specimens were collected and morphological measurements such as the shell length and shell width were recorded to the nearest millimetre (mm) (Table 2). Eight specimens were deposited in the collections of the Bombay Natural History Society (BNHS GASTRO-1080) and two specimens were deposited in the collection of Zoological Survey of India, Kolkata (Regd No. M-32387/9: 2 exs.).

Results

Systematic accounts

Phylum: Mollusca Linnaeus, 1758
Class: Gastropoda Cuvier, 1795
Superfamily: Buccinoidea Rafinesque, 1815
Family: Colubrariidae Dall, 1904
Genus: *Colubraria* Schumacher, 1817
Species: *nitidula*

Synonyms: *Triton nitidulus* G.B. Sowerby I, 1833 (original combination); *Tritonium* (*Colubraria*) *nitidula* von Martens, 1880; *Triton* (*Epidromus*) *nitidula* var. Sowerby, 1889a, p. 7. 1892.

Distribution: Widespread in Indo-West Pacific region.
Size: Length 27–36 mm; width 8–13 mm.

Table 1: Family Colubrariidae found in India and its status

S. No.	Name	New name (WoRMS database)	Reference to its occurrence in Indian waters
1	*Colubraria muricata* (Lightfoot, 1786)	Valid	Mohanraj *et al.* (2015); Subba Rao (2003); Tudu *et al.*(2018)
2	*Lotorium (Epidromus) nitidulum* (Sowerby)	Valid; *Colubraria nitidula* (Sowerby I, 1833)	Melvill and Sykes (1897)
3	*Colubraria obscura* (Reeve, 1844)	Valid	Subba Rao and Dey (2000)
4	*Colubraria sowerbyi* (Reeve, 1844)	Valid	Apte (2014)
5	*Colubraria tortuosa* (Reeve, 1844)	Valid	Subba Rao (2003)
6	*Metula andamanica* E.A. Smith, 1906	Valid	Dey (2016)

Fig. 1: *Colubraria nitidula*: a & c. Apertural view; b & d. Abapertural view

Table 2: Morphological measurements of the collected specimens

S. No.	Shell length (mm)	Shell width (mm)
1	30	10
2	28	12
3	34	13
4	36	13
5	27	9
6	33	10
7	27	8
8	28	8

N.B. The table gives the range of measurements from 8 of the 10 specimens collected

Description

Shell elongate-turreted, thick and solid with 10 to 12 flattened varices. Spire slightly twisted. Body whorl and spire granulated, arranged in raised lines. Columella smooth, with distinct enamel that is widely spread. Siphonal canal short and recurved. Outer lip with 9–12 denticles. Inner lip with smooth margin. Shell colour light brown with darker brown spot (Figs 1 a–d).

Discussion

Identification of the specimens was based purely on shell structure (Reeve 1844), since all the specimens found were dead and occupied by hermit crabs. However, the characteristics of these dead shells are distinct enough to segregate them from similar-looking *Colubraria* species, especially *C. ceylonensis* (G.B. Sowerby I, 1833). Final varix is directly under the varix of penultimate whorl in the case of *C. nitidula*, while in *C. ceylonensis* penultimate varix is about 270° to 350° from the final varix (Parth 1992). Also, the length of *C. ceylonensis* is between 40–45 mm, while in *C. nitidula* it varies between 20–60 mm.

Dey (2016) made an erroneous citation about *Colubraria nitidulum* in CATALOGUE OF MARINE MOLLUSCA: GASTROPODA with the cross references of Melvill and Sykes (1897), wherein Melvill and Sykes have mentioned the species as *Lotorium* (*Epidromus*) *nitidulum* without any drawing or description of the specimen. Further, Dey (2016) adopted *Colubraria nitidulum* from Sowerby's *Columbella nitidula*, which in fact is *Nitidella nitida* (Lamarck, 1822). These are two different species altogether. The reporting of the species from Andaman Is. is thus not clear, but may be considered as valid in the absence of better evidence. Apte (2014) reported *Colubraria sowerbyi* (Reeve, 1844) from Andaman Is. on the basis of a single specimen. Further studies are necessary to establish its presence in these islands. Nevertheless, the reporting of *C. nitidula* in very large numbers in the current note is substantial evidence about occurrence of the species in Indian waters and species of such nature are interesting from the taxonomic point of view, reported probably for the first time after its original but doubtful reporting.

REFERENCES

APTE, D.A. (2014): Sea Shells of India: An Illustrated Guide to Common Gastropods. Bombay Natural History Society and Oxford University Press. 225 pp.

DEY, A. (2016): Catalogue of Marine Molluscs (Polyplacophora and Gastropoda). Zoological Survey of India, Kolkata. 687 pp. + 192 pl.

MELVILL, J.C. & E.R. SYKES (1897): Notes on a collection of marine

shells from the Andaman Islands, with descriptions of new species. *Proc. malac. Soc. Lond. 2*: 164–172.

Mohanraj Jayaraj, Gurusamy Chelladurai, Srinivasan Balakrishnan & Iruthayam Vijaya Kumar (2015): Gulf of Mannar Island coral reef associated gastropods assemblages: Distribution and diversity pattern. *Journal of Coastal Life Medicine 3(9)*: 691–695. doi: 10.12980/jclm.3.2015jclm-2015-0023.

Parth, Manfred (1992): Some notes on the genus *Colubraria* Schumacher, 1817, with description of *Colubraria brinkae* sp. nov. *Spixiana 15(2)*: 213–220.

Reeve, L.A. (1844): Monograph of the genus *Triton*. *In*: Reeve, L.A. (Ed.): *Conchologia Iconica*, 2: pl. 14, species 54. Reeve & Co., London.

Subba Rao, N.V. (2003): Indian Seashells (Part I): Polyplacophora and Gastropoda. *Rec. Zool. Surv. India,* Occ. Paper No. 192 (i–x): 1–416.

Subba Rao, N.V. & A. Dey (2000): Catalogue of Marine Molluscs of Andaman and Nicobar Islands. *Rec. Zool. Surv. India,* Occ. Paper No. 187, i–x, 1–323 pp.

Tudu, P.C., P. Yennawar, N. Ghorai, B. Tripathy & A. Mohapatra (2018): An updated checklist of marine and estuarine molluscs of Odisha coast. *Ind. Jour. Geo-Marine Sciences 47(08)*: 1537–1560.

Recommended Citation

Apte, Deepak (2019): First record of *Colubraria nitidula* (Sowerby I, 1833) (Mollusca: Gastropoda) from Lakshadweep Islands, India. *J. Bombay Nat. Hist. Soc. 116*: 153–155. doi: 10.17087/jbnhs/2019/v116/121555

39. CORRECTION OF AN ORTHOGRAPHICAL ERROR IN *RICCIA 'INDIRA-GANDHIENSIS'* (RICCIACEAE: MARCHANTIOPHYTA)[1]

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[1]Accepted July 17, 2018
First published: May 31, 2019 | doi: 10.17087/jbnhs/2019/v116/123638
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Introduction

Validly published names should be in accordance with the rules of International Code of Nomenclature (ICN) for algae, fungi, and plants (Turland *et al.* 2018). Though *Riccia indira-gandhiensis* is validly published, the specific epithet is a feminine adjective which was wrongly given a geographical termination. Therefore, the specific epithet is liable for correction to *R. indira-gandhiana.*

Discussion

Dabhade and Hasan (1986: 400) validly published the name *Riccia indira-gandhiensis*. The proposed specific epithet commemorates the former Prime Minister of India, Mrs Indira Gandhi (1917–1984). However, the feminine adjectival epithet was wrongly given a geographical termination "-ensis" denoting a place name, but not a person's name (vide ICN Rec. 60D.1, Turland *et al.* 2018). According to ICN Art. 60.8, Ex. 19, the error in the termination of the epithet *indira-gandhiensis* is correctable. Accordingly, the epithet is corrected to *indira-gandhiana*, a feminine adjective in nominative refering to a person.

Riccia indira-gandhiana Dabhade & A. Hasan, *J. Bombay Nat. Hist. Soc. 83(2)*: 400. 1986, ('*indira-gandhiensis*')

Type: India: Maharashtra, Poona, 20.viii.1981, G.T. Dabhade 103 (Holotype: Dabhade's collection; Isotype: LWU).

ACKNOWLEDGEMENTS

The authors thank the Director of the Botanical Survey of India for facilities and encouragement, and for financial assistance to the first author under the 'Flora of India' project. The authors are grateful to Dr Kanchi N. Gandhi, Harvard University Herbaria, Massachusetts, USA, for confirming the orthographic error in the specific epithet, and critically refining the manuscript. The authors also thank Dr John McNeill, Royal Botanic Garden, Edinburgh, for providing the pages of the Shenzhen code for citing examples and the unknown reviewer for constructive comments and valuable suggestions for correcting the manuscript.

REFERENCES

Dabhade, G.T. & A. Hasan (1986): New species of *Riccia – Riccia indira-gandhiensis* sp. nov. *J. Bombay Nat. Hist. Soc. 83(2)*: 398–401.

Turland, N.J., J.H. Wiersema, F.R. Barrie, W. Greuter, D.L. Hawksworth, P.S. Herendeen, S. Knapp, W.-H. Kusber, D.-Z. Li, K. Marhold, T.W. May, J. Mcneill, A.M. Monro,

J. Prado, M.J. Price & G.F. Smith (2018): International Code of Nomenclature for algae, fungi and plants (Shenzhen Code). Regnum Veg. Vol. 159. Koeltz Scientific Books, Königstein, pp. 254.

Recommended Citation

Majumdar, Shuvadeep and Monalisa Dey (2019): Correction of an orthographical error in *Riccia 'indira-gandhiensis'* (Ricciaceae: Marchantiophyta). *J. Bombay Nat. Hist. Soc. 116*: 155–156. doi: 10.17087/jbnhs/2019/v116/123638

40. THE GENUS *NYMPHAEA* L. (FAMILY NYMPHAEACEAE) IN ANDAMAN AND NICOBAR ISLANDS, INDIA[1]

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[1]Accepted June 01, 2018
First published: May 31, 2019 | doi: 10.17087/jbnhs/2019/v116/108147
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Introduction

Nymphaea L. is an aquatic genus of the family Nymphaeaceae, with about 50 species, mostly distributed in the tropical and temperate regions of the world. This genus is represented in India by 16 species and 8 varieties (Ansari and Jeeja 2009). Of these, only two species, namely *Nymphaea nouchali* Burm.f. and *N. pubescens* Willd. were recorded so far from the Andaman and Nicobar Islands. The number of *Nymphaea* species introduced into the Andaman and Nicobar Islands is comparatively less because of the lesser number of freshwater aquatic habitats (Vivek *et al.* 2015), though the Islands are unique and richest in the country in terms of biodiversity (Singh and Murugan 2014).

During floristic explorations in the Andaman and Nicobar Islands, the authors came across two more interesting species of *Nymphaea* in the coastal ponds. After critical study, perusal of relevant literature (Bentham and Hooker 1862–1883; Cook 1996; Duthie 1903; Hooker 1872–1897; Linnaeus 1753; Mabberley 2008; Pandey and Diwakar 2008; Scott 1989; Singh and Murugan 2014) and consultation of herbaria at CAL, PBL, the authors identified them as *Nymphaea micrantha* Guill. & Perr. and *N. omarana* Hort ex Gard. The literature survey (Pandey and Diwakar 2008; Parkinson 1923; Singh and Murugan 2014) revealed that these two species have not been reported so far from the Andaman and Nicobar Islands, hence they are reported here as new records.

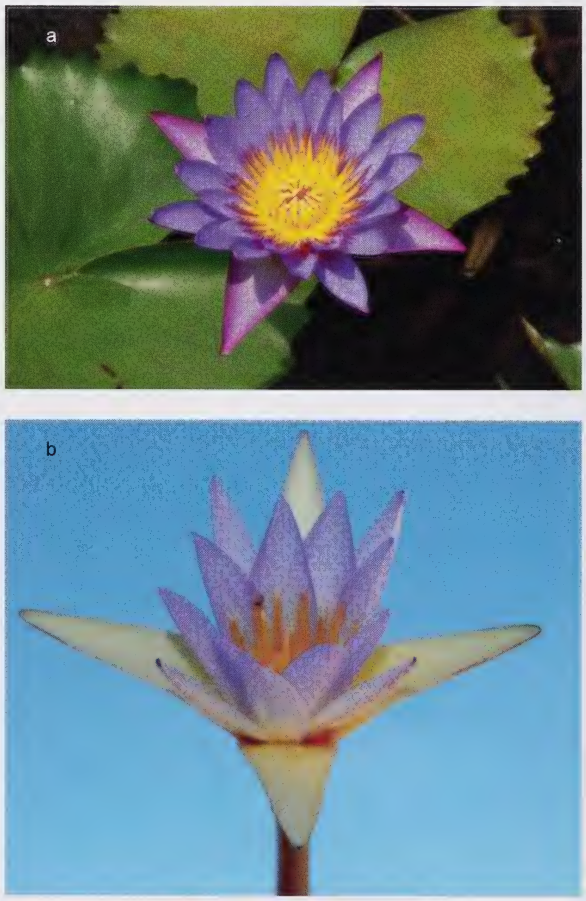

Fig. 1: a) *Nymphaea micrantha* Guill. & Perr., b) *N. nouchali* Burm. f.

Key to the species

1. Lower surface of leaves, petiole, and receptacle pubescent 2

— Lower surface of leaves, petiole, and receptacle glabrous.....3
2. Flowers pinkish to reddish, anthers pinkish or yellowish, filaments pinkish to purplish.....***N. omarana***
— Flowers white, anthers yellow, filaments white or pale yellow.....***N. pubescens***
3. Flowers purple, *c.* 12 cm across; stamens more than 130; carpels 18–21 in number.....***N. micrantha***
— Flowers white with or without pink or purple shade or dots, *c.* 5 cm across; stamens less than 60; carpels 5–15 in number.....***N. nouchali***

Nymphaea micrantha Guill. & Perr., Fl. Seneg. Tent. 1: 16. 1830; Conard in Carnegie Inst. Wash. Publ. 4: 146, Pl. 16. 1905; R.L. Mitra in B.D. Sharma *et al.*, Fl. India 1: 434. 1993. (Fig. 1a).

Leaves subpeltate, 14–25 x 10–20 cm, glabrous on both sides; veins *c.* 18 in number; petiole glabrous. Flowers purple, fragrant, *c.* 12 cm across. Sepals green with reddish streaks on outer surface, pale purple inside. Petals 20–25 in number. Stamens 130–150 in number; anthers 8–12 mm long, purplish; sterile filaments *c.* 5 mm long. Carpels 18–21 in number; stigmatic appendages oblong, yellow. Fruit *c.* 3 cm diam, with persistent floral whorls. Seeds ellipsoid, brown with dark brown longitudinal ridges.

Flowering & Fruiting: Throughout the year.

Distribution: Native of Africa. India. New distributional record for the Andaman & Nicobar Islands.

Notes: The flowers emit good fragrance, blossom in the morning and remain open up to 6 pm.

Specimens examined: INDIA: Andaman & Nicobar Islands, South Andaman, Nayashahar, 14.vii.2015, C.P. Vivek 32306 (PBL).

Nymphaea nouchali Burm. f., Fl. Ind.: 120. 1768; R.L. Mitra in B.D. Sharma *et al.*, Fl. India 1: 430. 1993. (Fig. 1b).

Leaves subpeltate, *c.* 19 x 16 cm, glabrous on both surfaces; veins *c.* 15 in numbers; petiole glabrous. Flowers white with or without pink or purple shade or dots, slightly fragrant, *c.* 5 cm across. Sepals green with pinkish margins outside, white with greenish tinge and purplish streaks inside. Petals 12–20 in number. Stamens 25–56 in number; filaments yellow; anthers 5–12 mm long, yellow. Carpels 5–15 in number. Fruit *c.* 2.5 cm diam., with persistent sepals. Seeds ellipsoid with pinkish longitudinal ridges.

Flowering & Fruiting: Throughout the year.

Distribution: Sri Lanka, India: Throughout the country.

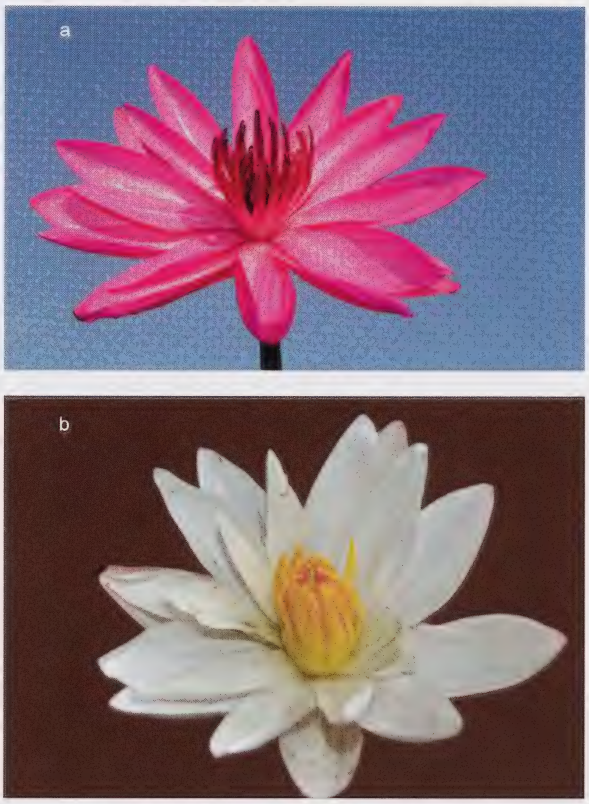

Fig. 2: a) *Nymphaea omarana* Hort ex Gard., b) *N. pubescens* Willd.

Notes: The flower blossoms in the morning and remains open up to 15:00 hours.

This is a highly variable species, growing in seasonal ponds, marshy areas, ditches and canals. The flower measures 5 to 9 cm across. Colour of the petals varies from pure white to white with bluish, pinkish or purplish shades. The flowers are fragrant and the seeds are edible.

Specimens examined: INDIA: Andaman & Nicobar Islands, North Nicobar, Trinket Island, 07.xii.2014, M.Y. Kamble 32144 (PBL).

Nymphaea omarana Hort ex Gard., Tr. 8: 96. 1895; Conard in Carnegie Inst. Wash. Publ. 4: Pl. 30. 1905. (Fig. 2a).

Leaves subpeltate, *c.* 35 x 32 cm, glabrous above, velutinous pubescent below; veins *c.* 15–17 in number; petiole pubescent. Flowers rose to pinkish rose, not fragrant, up to 18 cm across. Sepals pinkish green on outer surface. Petals 16–25 in number, with prominent veins. Stamens 50–80 in number, erect, forming a tube; filaments pink; anthers 10–20 mm long, pink; sterile filaments absent. Carpels 16–20 in number. Fruits with persistent floral whorls. Seeds ellipsoid, with pink longitudinal ridges.

Flowering & Fruiting: July–December.

Distribution: Indonesia, Malaysia, Myanmar, Sri Lanka, INDIA: Throughout the plains; new distributional record in the Andaman & Nicobar Islands.

Notes: The flowers blossom at dusk and remain open up to 11 am.

Specimens examined: INDIA: Andaman & Nicobar Islands, North Andaman, Diglipur, R. Gram, 29.xii.2013, Lal Ji Singh 29626 (PBL);South Andaman, Bambanala, 05.i.2015, M.Y. Kamble 32186 (PBL).

Nymphaea pubescens Willd., Sp. Pl. 2: 1154. 1799; R.L. Mitra in B.D. Sharma *et al.*, Fl. India 1: 431. 1993. (Fig. 2b).

Leaves subpeltate, broadly ovate to orbicular, up to 45 x 43 cm; basal, velutinous pubescent; veins *c.* 15 in number; petiole velutinous pubescent. Flowers white, outer whorl with light pink shade, slightly fragrant, up to 20 cm across. Sepals green and pubescent outside, white inside. Petals 10–25 in number, outer ones white with or without slight pink shade; inner ones white. Stamens up to 80 in number; filaments forming a tube around stigma; anthers 5–20 mm long, yellow; sterile filaments not prominent. Carpels 18–20 in number. Fruits with persistent floral whorls. Seeds globose to ellipsoid with greenish or greyish longitudinal ridges.

Flowering & Fruiting: Throughout the year.

Distribution: Bangladesh, Cambodia, Indonesia, Malesia, New Guinea, Philippines, Sri Lanka, and Vietnam. INDIA: Throughout the country.

Notes: The flowers blossom in the morning and remain open up to noon.

Specimens examined: INDIA: Andaman & Nicobar Islands, Little Andaman, Hut Bay, Nanjappa Nagar, 01.iv.2012, Lal Ji Singh 29506 (PBL).

Discussion

The biggest threat not only to the *Nymphaea* species but to all aquatic plants in the Andaman and Nicobar Islands is direct habitat loss because of natural calamities like tsunami, cyclones, and anthropogenic activities concerned with settlement, and conversion of land to agriculture.

The taxonomy of family Nymphaeaceae is complicated because of natural hybridization. These plants can survive in permanent freshwater bodies, marshy lands, and seasonal ponds, and tide over summer by remaining dormant under the soil until water is available in the next season. However, they do prefer to grow in good freshwater habitats. These plants have been traditionally used for diverse purposes, particularly for food, fibre, medicine, and for ornamental value. They also play a vital role in determining the primary productivity of the aquatic ecosystem. During our survey, only a limited number of freshwater habitats with poor diversity were observed in the Andaman and Nicobar Islands. Only four species of *Nymphaea* were seen to be acclimatized to the seasonal freshwater ponds and marshy land of these Islands. These species have been introduced at Dhanikhari Experimental Garden cum Arboretum (DEGCA), Nayashahar, BSI, ANRC.

ACKNOWLEDGEMENT

The authors are grateful to Dr P. Singh, Director, Botanical Survey of India, Kolkata, for providing facilities and encouragement.

REFERENCES

ANSARI, R. & G. JEEJA (2009): Waterlilies in India. Taxonomy and Cultivation of the genus *Nymphaea* L. (Nymphaeaceae). IAAT, Kerala.

BENTHAM, G. & J.D. HOOKER (1862–1883): Genera Plantarum.Vols 1–3. London, UK.

COOK, C.D.K. (1996): Aquatic and Wetland Plants of India. Oxford UniversityPress, Oxford.

DUTHIE, J.F. (1903): Flora of Upper Gangetic Plains, Adjacent Shivalik and Sub-Himalayan tract. Published by Superintendent Government Printing, India, Calcutta, vol. 2, pp. 470.

HOOKER, J.D. (1872–1897): The Flora of British India, Vol. 17. L. Reeve, London.

LINNAEUS, C. (1753): Species Plantarum. Ed. 2. Impensis Laurentii Salvii, Stockholm.

MABBERLEY, D.J. (2008): Mabberley's Plant Book – A Portable Dictionary of Plants, Their Classification and Uses. Cambridge University Press, UK.

PANDEY, R.P. & P.G. DIWAKAR (2008): An integrated checklist of flora of Andaman and Nicobar Islands, India. *J. Econ. Taxon. Bot. 32*: 403–500.

PARKINSON, C.E. (1923): A Forest Flora of the Andaman Islands. Simla.

SCOTT, D.A. (1989): A Directory of Asian Wetlands. IUCN Publications, Gland, Switzerland.

SINGH, L.J. & C. MURUGAN (2014): Seed plant species diversity and conservation in Dhanikhari Experimental Garden cum Arboretum in Andaman and Nicobar Islands, India. *In*: Nehra S., R.K. Gothwal & P. Ghosh (Eds): Biodiversity in India: Assessment, Scope and Conservation. Lambert Academic Publishing, Sarbruken, Germany.

VIVEK, C.P., L.J. SINGH & M.Y. KAMBLE (2015): Aquatic and wetland plant diversity and climate change in Andaman and Nicobar Islands. *In*: National Seminar on Harmonizing Biodiversity and Climate Change: Challenges & Opportunity, Port Blair. (Abs. 91).

Recommended Citation

Kamble, M.Y., Vivek C. Poulose and Lal Ji Singh (2019): The genus *Nymphaea* L. (Family Nymphaeaceae) in Andaman and Nicobar Islands, India. *J. Bombay Nat. Hist. Soc. 116*: 156–157. doi: 10.17087/jbnhs/2019/v116/108147

41. *CARDAMINE AFRICANA* AND *CARDAMINE OCCULTA*: TWO NEW RECORDS OF FAMILY BRASSICACEAE FROM THE STATE OF MAHARASHTRA, INDIA[1]

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[1]Accepted March 20, 2018
First published: March 29, 2019 | doi: 10.17087/jbnhs/2019/v116/117613
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Introduction

The family Brassicaceae Burnett (earlier known as Cruciferae), or the mustard family, comprises about 372 genera and more than 4,060 species (The Plant List 2013). Genus *Cardamine* L. belongs to the tribe Arabideae and is cosmopolitan in its distribution, represented by *c.* 200 species (Mabberley 2008; Sharma and Balakrishnan 1993). In India, the genus comprises about 14 species (Sharma and Balakrishnan 1993), of which 12 are reported from Western Ghats (Nayar *et al.* 2014). In Maharashtra, only a single species *C. trichocarpa* Hochst. ex A. Rich. was known so far (Singh and Karthikeyan 2000). During floristic exploration in Maharashtra, the authors collected several specimens of two interesting species of *Cardamine*, growing near moist shady places. After consulting relevant literature (Marhold *et al.* 2016; Schulz 1903), one was identified as *Cardamine occulta* Hornem. from Kolhapur, Pune, Sindhudurg, Amboli, Amba, while the other was identified as *Cardamine africana* L. from the Konkan region. Both species are new records for the state of Maharashtra (Singh and Karthikeyan 2000), hence these have been presented here with their description and ecology.

Cardamine africana L. Sp. Pl. 655. 1753; Hook. f. & T. Anderson in Fl. Brit. India 1: 137. 1872.

Lectotype: (designated by Sjöstedt, 1975: 9): Hermann, P., Paradisus batavus, 1698, plate for p. 202.

Annual, erect, branched herb, 50–60 cm long. Roots branched, fibrous. Stem woody at base, sparsely hairy, distinctly grooved. Leaves compound trifoliolate, sparsely hairy on both sides; petioles 1–4 cm long; leaflets ovate, lateral leaflets 1–4 x 1–2 cm, oblique at base, acute apex, sparsely hairy on both sides, margin crenate-serrate, petiolulate; petiolule up to 1.5 cm long. Inflorescence 10–20 flowered terminal racemes. Flowers 6–8 mm, yellowish white with 1–2 mm short pedicels, ebracteate; sepals 4, lanceolate-oblong, green, *c.* 2.0 x 1.5 mm; petals obovate-cuneate, *c.* 4 x 1 mm, dirty white or greenish white, nearly twice as long as sepals; stamens 4, filament 1–4 mm long, extrorse; carpel 2, style short, *c.* 1 mm, stigma capitate; ovules 7–12. Fruits erect, narrowed at both ends, *c.* 3.5 cm long, seeds 5–10, flat-elliptic, brown.

Ecology *Cardamine africana* grows in humid, wet, and shady places in association with *Cardamine trichocarpa* Hochst. ex A. Rich., *Oxalis corniculata* L., *Setaria pumila* (Poir.) Roem. & Schult., and *Dentella repens* (L.) J.R. Forst. & G. Forst.

Flowering and fruiting: October to January.

Distribution: India (Arunachal Pradesh, Karnataka, Maharashtra, Tamil Nadu), Africa, Sri Lanka, Indonesia (Sharma and Balakrishnan 1993).

Specimens examined: INDIA: Tamil Nadu: Coonoor. 14.i.2017, J.V. Dalavi JVD-412 (SUK!); INDIA: Maharashtra:

Table 1: Comparative account of some morphologically important characters of *Cardamine occulta*, *C. hirsuta*, and *C. flexuosa*

Characters	*Cardamine occulta*	*Cardamine hirsuta*	*Cardamine flexuosa*
Leaves	glabrous on upper surface or sparsely ciliate along margins	hirsute	with scattered hairs on upper surface
Arrangement of leaves	rarely in rosette or rosette structure not persistent	in dense, branched persistent rosette at base	in small unbranched rosette
Length of pedicel	3–8 mm	5–10 mm	5–10 mm
Stamens	6	4	6

Kolhapur; Amba. 26.i.2017, J.V. Dalavi JVD-413 (SUK!).

Cardamine occulta Hornem., Suppl. Hort. Bot. Hafn.: 71. 1819.

Epitype: China, Zhejiang Province, Linhai County, Kuocang Mountains, in ditch along the road, 28° 50.35′ N; 120° 58.90′ E, 79 m, 18.iv.2014, K. Marhold CH18/12/2014, Yunpeng Zhao & Ming Jiang – (SAV0006529) (SAV!).

Annual, diffused much branched herb, 7–30 cm in height. Roots branched, fibrous. Stem herbaceous, green, angular, longitudinally grooved, sparsely hairy. Leaves simple dissected, irregularly lobed, lobes cloverleaf to kidney-shaped, 3.6–5.5 × 2.7–5 cm, glabrous or pubescent, dark green, basal leaves in dense rosette, orbicular; petioles 1.0–1.5 cm. Inflorescence 8–15 flowered racemes. Flowers 0.5–0.6 cm, pedicellate, pedicel 1–2 mm, white; sepals 4, oblong, 1.5–2.0 mm, hirsute, green; petals 4, 2.5–3.5 × 1.0–1.5 mm, white; stamens 6, 0.7–1.1 mm, didynamous, dorsifixed, extrorse, longitudinally dehiscent; style reduced; stigma entire and globose; ovary 2 mm, cylindrical, smooth, multi-ovulate. Siliques 2.0–2.5 × 0.1–0.2 cm, compressed, erect, greenish brown. Seeds 1 mm, oval, pale brown.

Ecology: *Cardamine occulta* is a polyploid weed that most likely originated in Eastern Asia, but has also been introduced to other continents, including Europe (Marhold *et al.* 2016). It grows in shady, humid, and wet localities of Konkan, Kolhapur, Pune, and Satara districts of Maharashtra and is commonly associated with *Peperomia pellucida* (L.) Kunth, *Oxalis corniculata* L., *Laportea interrupta* (L.) Chew, and *Dentella repens* (L.) J.R. Forst. & G. Forst.

Flowering and fruiting: Throughout the year

Distribution: Darjeeling, West Bengal, India (Marhold *et al.* 2016).

Specimens examined: INDIA: Maharashtra: Malkapur (Kolhapur). 05.ii.2017, J.V. Dalavi and S.P. Bramhadande JVD-414 (SUK!); Vengurla (Sindhudurg). 03.iii.2017, J.V. Dalavi and P.R. Mane JVD-415 (SUK!); Shivaji University Campus (Kolhapur). 27.viii.2016, S.D Patil, V.S. Patil and J.V. Dalavi JVD-416 (SUK!); Shirol (Kolhapur). 12.viii.2016, J.V. Dalavi JVD-414 (SUK!)

Notes: *Cardamine occulta* grows in shady, wet places and on walls. It is a highly polymorphic species. On dehiscence of siliqua, the epicarp gets curled and seeds are dispersed. In the Indian subcontinent, *C. occulta* is wrongly identified as either *C. flexuosa* or *C. hirsuta.* Therefore, a comparative account of some morphologically important characters is given in Table 1 for easy identification.

ACKNOWLEDGEMENTS

The authors are thankful to the Head, Department of Botany, Shivaji University Kolhapur, for laboratory facilities, Dr. Karol Marhold, Department of Vascular Plant Taxonomy, Institute of Botany SK-845 23 Bratislava, Slovak Republic, for confirming the identification and Ministry of Environment, Forest and Climate Change for financial support [F. No. 28011/11/2015 RE (Tax)].

REFERENCES

HERMANN, P. (1698): *Paradisus Batavus.* Abraham Umelzevier, Academia Typographum. M Dc Xcviii. Plate 202.

MABBERLEY, D.J. (2008): The Plant Book. 3rd edn. Cambridge University Press, Cambridge. Pp. 151.

MARHOLD, K., M. ŠLENKER, H. KUDOH & J. ZOZOMOVÁ-LIHOVÁ (2016): *Cardamine occulta,* the correct species name for invasive Asian plants previously classified as *C. flexuosa*, and its occurrence in Europe. *Phyto Keys 62*: 57–72

NAYAR, T.S., A.R. BEEGAM & M. SIBI (2014): Flowering Plants of the Western Ghats of India. Vol. 1. St. Joseph's Press, Thiruvananthapuram, Kerala. Pp. 293–299.

SCHULZ, O.E. (1903): *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie.* Leipzig Von Wilhelm Engelmann. Vol. 32. pp. 479.

SHARMA, B.D. & N.P. BALAKRISHNAN (1993): Flora of India. Vol. 2. Botanical Survey of India. Calcutta. Pp. 108–118.

SINGH, N.P. & S. KARTHIKEYAN (2000): Flora of Maharashtra. Vol. 1. Botanical Survey of India; Calcutta. Pp. 193–195.

The Plant List (2013): Version 1.1. Published on the Internet; http://www.theplantlist.org/ Accessed on January 01, 2016.

Recommended Citation

Dalavi, Jagdish V., Vaishali S. Patil, Sayali D. Patil, Sneha P. Bramhadande and Shrirang R. Yadav (2019): *Cardamine africana* and *Cardamine occulta*: Two new records of Family Brassicaceae from the State of Maharashtra, India. *J. Bombay Nat. Hist. Soc. 116*: 159–160. doi: 10.17087/jbnhs/2019/v116/117613

42. TWO NEW DISTRIBUTIONAL RECORDS IN GENUS *SIDA* L. TO THE FLORA OF MAHARASHTRA STATE, INDIA[1]

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[1]Accepted September 21, 2018
First published: December 31, 2019 | doi: 10.17087/jbnhs/2019/v116/149731
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Introduction

During botanical explorations in Maharashtra State, a few interesting specimens of the genus *Sida* were collected from various locations. A critical examination of the specimens and survey of literature (Almeida 1996; Sivadasan and Anil Kumar 1996; Sivarajan and Pradeep 1990, 1994; Sivarajan *et al.* 1992; Venkanna and Das Das 2000) revealed that some of them belonged to *Sida fryxellii* Sivar. & Pradeep and *S. repens* Dombey ex Cav. The literature also revealed that these species had not been reported from Maharashtra State before, therefore, they are reported here as new records to the flora of Maharashtra.

The voucher specimens have been deposited in the Herbarium of Department of Botany, Savitribai Phule Pune University (SPPU), Pune, Maharashtra.

Family Malvaceae is one of the largest and most diverse families of flowering plants (Sivarajan and Pradeep 1990). In the broader APG circumscription, family Malvaceae *s.l.* comprises four traditional families, namely Malvaceae *s.s.*, Bombacaceae, Sterculiaceae, and Tiliaceae. Thus, the family Malvaceae *s.l.* is now represented by 245 genera, 4,465 species, and 1,802 infraspecific taxa (The Plant List 2013). In India, Malvaceae *s.s.* is represented by 22 genera and 93 species (Paul 1993).

Genus *Sida* L. with about 200 species is widely distributed along the tropical and subtropical regions of the world (Paul and Nayar 1988) and represented by 20 species in India (Tambde *et al.* 2016a) and 17 species in peninsular India (Sivarajan and Pradeep 1996). Almeida (1996) reported seven species and two varieties, whereas Venkanna and Das Das (2000) reported 8 species and one infraspecific taxon for Maharashtra state. However, very recently Tambde *et al.* (2016b) have reported 11 species and one variety of the genus for Maharashtra.

Enumeration of Taxa

Sida fryxellii Sivar. *et* Pradeep in Kew Bull. 45: 725. 1990; Sivar. & Pradeep, Malvaceae South. Penin. India. 259. 1996.

S. rhombifolia subsp. *rhombifolia* var. *rhombifolia* sensu Paul in B.D. Sharma *et al.* Fl. India 3: 289. 1993 (non L., 1753).

Erect undershrub; stem terete, densely stellate-pubescent with occasional simple hairs. Leaves dimorphic, early ones obovate-orbicular, obtuse, retuse at apex; later ones ovate or elliptic, obtuse, rounded or acute at base, crenate-serrate at margins. Flowers axillary, solitary. Calyx campanulate, 5-lobed, densely stellate-pubescent outside, sparsely within. Corolla yellow, petals obliquely obovate, ciliate at base. Staminal column stellate-hairy. Mericarps 8–10, trigonous. Seeds brownish to black, laterally compressed.

Flowering & Fruiting: November–March.

Distribution: INDIA: Kerala, Maharashtra (Gadchiroli: present study).

Exsiccata: Maharashtra: Gadchiroli district, M.M. Sardesai 17429, 05.xi.2013, 6688 (SPPU).

Note: According to Sivarajan and Pradeep (1990), *Sida fryxellii* is similar to *S. cordifolia*, but differs from it in having dimorphic leaves and mericarps with stellate-hairy awns. But Paul (1993) considered this taxon as more allied to *S. rhombifolia* L. subsp. *rhombifolia* var. *rhombifolia*, and only a variant of it. However, as per our observations based upon the protologue, illustrations, holotype deposited at CALI and isotype at K (online image), and our own field and laboratory observations, the taxon is more similar to *S. cordifolia* L. and stands as a distinct species.

Sida repens Dombey ex Cav. Diss. 1: 7. 1785; Sivar. & Pradeep, Malvaceae South. Penin. India. 277. 1996.

S. javensis Cav. subsp. *expilosa* sensu Mathew & Sivar. in

J. Econ. Tax. Bot. 4: 619. 1983; Paul & Nayar in Nayar *et al.* (Eds) Fasc. Fl. India 19: 209. 1988; Paul in B.D. Sharma *et al.* (Eds) Fl. India 3: 286. 1993. (non Borss., 1966).

Prostrate herb. Stem rooting at nodes, densely covered with minute stellate hairs and long simple hairs. Leaves orbicular, cordate at base, rounded or obtuse, rarely acute. Flowers axillary, solitary initially, ultimately in few-flowered racemes. Calyx lobes minute, stellate-hairy outside, glabrous inside. Corolla yellow, petals obovate. Staminal column with patent simple hairs, basal part wide, conical. Mericarps 5, tetrahedral with rounded angles, hairy with 2 awns. Seeds ovoid.

Flowering & Fruiting.: October–January.

Distribution: West Indies and Malaysia. INDIA: Kerala, Maharashtra (Gadchiroli district: Present report).

Exsiccata: Maharashtra: Gadchiroli district, Coll.: M.M. Sardesai 17431, 07.xii.2013, 6669 (SPPU).

Note: This species is of rare occurrence, and grows on sandy soils.

ACKNOWLEDGEMENTS

The authors are thankful to the Head, Department of Botany, Dr Babasaheb Ambedkar Marathwada University, Aurangabad and Savitribai Phule Pune University, Pune, for providing laboratory and herbarium facilities. The authors are also thankful to Professor S.R. Yadav, Shivaji University, Kolhapur, for confirming the identifications.

REFERENCES

ALMEIDA, M.R. (1996): Flora of Maharashtra, Vol. 1. Orient Press, Mumbai. Pp. 94–129.

PAUL, T.K. (1993): Malvaceae. Pp. 257–394. *In*: (Eds: Sharma, B.D., N.P. Balakrishnan, R.R. Rao & P.K. Hajra): Flora of India, Vol. 3. Botanical Survey of India, Calcutta.

PAUL, T.K. & M.P. NAYAR (1988): Malvaceae. Pp. 64–233. *In*: (Eds: Nayar, M.P., K. Thothathri & M. Sanjappa): Fascicles of Flora of India, Botanical Survey of India, Calcutta. Fascicle 19.

SIVADASAN, M. & N. ANIL KUMAR (1996): *Sida ravii*, a new species of Malvaceae from India. *Willdenowia 25*: 651–654.

SIVARAJAN, V.V. & A.K. PRADEEP (1990): *Sida fryxellii*, a new species of Malvaceae from Peninsular India. *Kew Bulletin 45(4)*: 725–727.

SIVARAJAN, V.V. & A.K. PRADEEP (1994): Taxonomy of the *Sida rhombifolia* (Malvaceae) Complex in India. *Sida 16*: 63–78.

SIVARAJAN, V.V. & A.K. PRADEEP (1996): Malvaceae of Southern Peninsular India: A Taxonomic Monograph. Daya Publishing House, Delhi. Pp. 312.

SIVARAJAN, V.V., A.K. PRADEEP & E.J. GEORGE (1992): Mericarp morphology of Indian species of *Sida* L. (Malvaceae) in relation to taxonomy. *Journal of Taiwan Museum 45(1)*: 65–73.

TAMBDE, GAJANAN, VARSHA NIMBALKAR, MANOJ LEKHAK & MILIND SARDESAI (2016a): *Sida pradeepiana* (Malvaceae), a new species from India. *Nordic Journal of Botany 34*: 573–577. doi: 10.1111/njb.01147.

TAMBDE, GAJANAN M., RAMCHANDRA D. GORE & MILIND M. SARDESAI (2016b). A synopsis of the genus *Sida* L. (Malvaceae) from Maharashtra, India. *Taiwania 61(3)*: 243–252.

THE PLANT LIST (2013): Version 1.1. Published on the Internet; http://www.theplantlist.org/ (Accessed on January 01, 2019).

VENKANNA, P. & S.K. DAS DAS (2000): Malvaceae. Pp. 288–342. *In*: Singh, N.P. & S. Karthikeyan (Eds): Flora of Maharashtra State: Dicotyledones, Vol. I. (Ranunculaceae–Rhizophoraceae), Botanical Survey of India, Calcutta.

Recommended Citation

Govekar, R.S., T.D. Kamble, G.M. Tambde, V.V. Nimbalkar and M.M. Sardesai (2019): Two new distributional records in genus *Sida* L. to the flora of Maharashtra state, India. *J. Bombay Nat. Hist. Soc. 116*: 161–162. doi: 10.17087/jbnhs/2019/v116/149731

43. *CAJANUS ALBICANS* (WIGHT & ARN.) MAESEN (FAMILY: FABACEAE) – NEW DISTRIBUTIONAL RECORD TO THE ANDAMAN AND NICOBAR ISLANDS, INDIA[1]

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[1]Accepted May 28, 2019
First published: December 31, 2019 | doi: 10.17087/jbnhs/2019/v116/127402

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Introduction

The genus *Cajanus* DC. in India is represented by 16 species including 3 endemic species, namely *C. cajanifolius*, *C. sericeus*, and *C. villosus* (Sanjappa 1992; Singh *et al.* 2015; www.ildis.org). During floristic studies in Andaman Islands, one of the authors collected an interesting

specimen of legume which, after consulting literature (Sanjappa 1992; van der Maesen 1985), was identified as *Cajanus albicans* (Wight & Arn.) Maesen, which has been reported for the first time from Andaman and Nicobar Islands and forms a new distributional record to the region.

It is hard to find the reason for a deliberate introduction of *Cajanus albicans* into Andaman Is. from the mainland, but there are several possibilities. The seeds might have been carried by migratory birds, or it could be a human-mediated dispersal through transportation and then escape into the wild. The third possibility may be that the main population is from Andaman, and then it has spread to Sri Lanka and southern India.

Cajanus albicans can easily be distinguished in the field by characters such as climbing habit, sub-digitately trifoliate leaves, densely white pubescent lower surface of leaflets, 4–6 seeded pods, seeds greyish brown with dark brownish black blotches.

Cajanus albicans (Wight & Arn.) Maesen, Agric. Univ. Wageningen Pap. 85(4): 55. 1986; *Cantharospermum albicans* Wight & Arn., Prodr. Fl. Ind. Orient. 1: 256. 1834; *Atylosia albicans* (Wight & Arn.) Benth. in Miq., Pl. Jungh. 1: 243. 1852; Baker in Hook.f., Fl. Brit India 2: 215. 1876; Sanjappa, Legumes India: 99. 1992; Pullaiah *et al*. Fl. Andhra Pradesh rev. ed. 2: 423. 2018.

Woody climbers, up to 6 m long. Stem terete, whitish, pubescent. Leaves trifoliolate; petiole 1.0–4.0 cm long; stipules triangular, 1.0–2.0 mm long, acute, pubescent; leaflets green above, grey tomentose beneath with prominent veins, terminal leaflet ovoid to obovate, 2.0–4.0 × 1.0–2.2 cm, obtuse or subacute at apex, margin cuneate at base, lateral leaflets obliquely orbicular, 1.6–3.5 × 1.0–2.0 cm long. Inflorescence a lax raceme, 1–4 flowered; peduncle 1.0–4.0 cm long. Flowers yellow to orange; pedicels filiform, 0.5–1.2 mm long; bracts triangular, 0.8–1.0 mm long, pubescent; calyx shortly tubular 3.0–5.0 mm long, greyish tomentose, calyx teeth triangular; standard petal obovate, 1.0–1.2 cm long, clawed base, yellow with brownish base; wing petal obovate, 1.0–1.2 cm long, bi-auriculate, clawed base; keel petal obliquely orbicular, 1.0–1.2 cm, clawed. Stamens diadelphous, 16–18 mm long, upturned, anthers bithecous, dorsifixed. Ovary 6.0 mm long, densely pubescent; style 1.0–1.2 cm long, upcurved, pubescent; stigma capitate. Pods oblong, 1.5–4.0 cm × 0.7–0.8 cm, densely adpressed hairy, with transverse depressions at right angles to the sutures; seeds 2–7, rectangular, strophiolate, black with grey mosaic.

Flowering and fruiting: October to April.

Distribution: INDIA: Andaman Islands, Andhra Pradesh, Karnataka, Kerala, Odisha, and Tamil Nadu; Sri Lanka.

Habitat: Rare in littoral forests, seen in association with *Ziziphus rugosa* Lam., and *Hernandia nymphaeifolia* (C. Presl) Kubitzki.

Specimens examined: Andaman Islands: Wandoor. 11.iii.2017, Coll.: J.V. Dalavi JVD-817 (SUK!); Karnataka, Kollegal, Arepalagam, Coll.: Naganathan 78662 (MH!)

ACKNOWLEDGEMENTS

The authors are thankful to the Head, Department of Botany, Shivaji University, Kolhapur, for laboratory facilities, and Ministry of Environment, Forest and Climate Change for financial support (F. No. 28011/11/2015 RE (Tax)).

REFERENCES

BAKER, J.G. *In*: Hooker, J.D. (1876): The Flora of British India. L. Reeve and Co., London, p. 215.

ILDIS (INTERNATIONAL LEGUME DATABASE & INFORMATION SERVICE): http://www.ildis.org/ Accessed on May 01, 2018.

SANJAPPA, M. (1992): Legumes of India. Bishen Singh Mahendra Pal Singh, Dehradun, pp. 99–104.

SINGH P., K. KARTHIKEYAN, P. LAKSHMINARASIMHAN & S.S. DASH (2015): Endemic Vascular Plants of India. Botanical Survey of India, Kolkata, pp. 185.

VAN DER MAESEN, L.P.G. (1985): *Cajanus* DC. and *Atylosia* Wight and Arn. (Leguminosae). *Agricultural University Wageningen Papers 85(4)*: 55–61.

WIGHT, R. & G.A.W. ARNOTT (1834): *Prodromus Florae Peninsulae Indiae Orientalis*. Allen & Co., Parbury, 1. pp. 256.

Recommended Citation

Dalavi, Jagdish V., Sneha P. Bramhadande and Shrirang R. Yadav (2019): *Cajanus albicans* (Wight & Arn.) Maesen (Family: Fabaceae) – new distributional record to the Andaman and Nicobar Islands, India. *J. Bombay Nat. Hist. Soc. 116*: 162–163. doi: 10.17087/jbnhs/2019/v116/127402

44. *CARALLIA BORNEENSIS* OLIVER (FAMILY RHIZOPHORACEAE) – A NEW RECORD TO INDIA FROM ANDAMAN ISLANDS[1]

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[1]Accepted February 20, 2018
First published: March 29, 2019 | doi: 10.17087/jbnhs/2019/v116/105941
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Introduction

Though a member of family Rhizophoraceae, which is primarily mangrove vegetation, *Carallia* Roxb. is an inland forest taxon. It is distributed from Madagascar through India (Andaman and Nicobar Islands), Sri Lanka, Southeast Asia, and Malaysia, to north Australia. Murugan *et al.* (2016) and Hajra *et al.* (1999) recorded only one species from Andaman and Nicobar Islands, whereas South Asian countries like Sri Lanka recorded 4 species (Kostermans 1982), and China 4 species (Haining and Boufford 2007). Malaysia has 8 species (Ding Hou 1958); Madani and Wong (1995) enumerated 8 species in the flora of Sabah and Sarawak, in which 4 were unnamed. Globally, The Plant List (2013) included 56 scientific names of species rank for genus *Carallia*, but only 13 of them are accepted.

Andaman and Nicobar Islands represent one of the richest storehouses of plant diversity in the whole of South and Southeast Asia (Balakrishnan *et al.* 2008). The Andaman group of islands shows much closer affinity to the Myanmar flora, whereas Nicobar flora has affinity towards the Sunda group of islands (Arisdason and Lakshminarasimhan 2013). At the same time, Rasingam (2012), Karthigeyan *et al.* (2014) and Naik *et al.* (2014) have recorded Southeast Asian elements from the Andamans.

During a floristic survey in Snob Island in Mahatma Gandhi Marine National Park, South Andaman, *Carallia borneensis* Oliver of family Rhizophoraceae was found to be present, constituting a new record to Indian flora.

Carallia borneensis can easily be distinguished from the only other known species of the same genus in India, *Carallia brachiata*, using morphological and reproductive characters.

Key to species

1. Leaf margin generally entire; bract caducous; flowers sessile, resinous; ovary bulbous; stigma apically 4–8 lobed; fruits globose and red ..... *C. brachiata*
— Leaf margin distinctly serrate; bract persistent; flowers pedicellate, not resinous; ovary cylindric; stigma apically crenate; fruits oblong and purple..... *C. borneensis*

Carallia borneensis Oliver in Hook., Icon. Pl. (1896) t. 2459; Ding Hou, Fl. Males. ser. 1, 5 (1958) 484; *Carallia mindanaensis* (Merr.) Merr., EPFP 3 (1923) 146; *Sagittipetalum palawanense* Elmer, Leaft. Philip. Bot. 5 (1913) 146; *Sagittipetalum mindanaense* Merr., Philip. J. Sc. 3 (1908) Bot. 247.

Small tree, up to 5 m tall. Bark pale brown. Leaves broadly elliptic to elliptic-oblong, 4.5–9 x 2.8–6.5 cm, coriaceous, olive brown above, pale brown below when dry, with conspicuous dark gland-dots along the margin and apex of the lamina below; base cuneate, 1/3 of lower margin entire and 2/3 of upper margin distinctly toothed, revolute; apex abruptly acute to acuminate, base cuneate; main nerve impressed above, lateral veins 9–11 pairs, slightly distinct above, raised below; intercostal veins distinct but distant, 2 rows of loops 3–5 mm below the margin; petiole 5–8 mm long; stipules 7–12 mm long. Inflorescence 1.5–1.8 x 1.2–1.5 cm, axillary, evenly dichotomously branched cyme, rarely trichotomously branched; peduncle 5–7 mm long, angled; bracteate, broadly ovate, *c.* 1.5–2 mm, glabrous, forming a cup at every bifurcation; bracteoles 2, broadly ovate, glabrous, united into a basal cup. Flowers white or pale yellow, 5–7 mm across; pedicel 2.5–3.5 mm long, angled; calyx lobes 7, pink, *c.* 4 mm long, with short white hairs on inner side; petals sagittate, 6–8 mm long, clawed, margin fimbriate; stamens 14, of unequal lengths in 2 rows, stamens opposite to calyx shorter (epicalyx), opposite to corolla longer, filaments 3–5 mm long; anthers ovoid, apiculate; disc cup-shaped, very distinct, thick, fleshy, divided halfway into lobes (undulating); ovary cylindric, style 7–9 mm long, stigma discoid with crenate margin. Fruits oblong-ellipsoid, 8–10 x 4–6 mm, dark purple when ripe, crowned by persistent floral parts, one-seeded.

Flowering and fruiting: January to April.

Distribution: India (Andaman Islands), Borneo,

Malaysia, Philippines, and New Guinea.

Specimen examined: INDIA: South Andaman, Mahatma Gandhi Marine National Park, Snob Island, 27.iii.1997, 100 m, N. Balachandran AURO 0737.

Ecology: In an undisturbed moist deciduous forest under partial shade, at an elevation of 100 m, on the western slopes of a ravine with rocky outcrops.

Note: *Carallia borneensis* differs from *C. brachiata* in having elliptic leaves with distinctly serrate margin, dichotomously branched cyme, pedicellate flowers, from cup-shaped persistent bracts, sagittate petals, cylindric ovary, oblong-ellipsoid and purple fruits.

ACKNOWLEDGEMENTS

The authors are thankful to Andaman and Nicobar Environmental Team (ANET) for financial and logistic support during the survey. PCCF, Department of Forest and Wild Life, granted permission to carry out the botanical survey at South Andaman Islands; Dr C. Murugan, Scientist 'C' and in-charge, Botanical Survey of India, Port Blair, gave permission to consult the herbarium; Dr Francois Munoz, Head of the Department of Ecology, French Institute of Pondicherry, gave us constant support and encouragement. The authors also thank Mr K. Ramesh Kumar for photography.

REFERENCES

ARISDASON, W. & P. LAKSHMINARASIMHAN (2013): An outline of plant diversity in the Andaman and Nicobar Islands. http://www.bsienvis.nic.in

BALAKRISHNAN, M., R.C. SRIVASTAVA & M. POKHRIYAL (2008): Biodiversity of Andaman and Nicobar Islands. *Biobytes 3*: 9–12.

DING HOU, L. (1958): Rhizophoraceae. Pp. 483–487. *In*: Flora Malesiana. van Steenis C.G.G.J. (Ed.). Vol. 1. Noordhoff-Kolff, N.V., Djakarta.

HAINING, Q. & D.E. BOUFFORD (2007): Rhizophoraceae. Pp. 295–299. *In*: Flora of China, Vol. 13.

HAJRA, P.K., P.S.N. RAO & V. MUDGAL (1999): Flora of Andaman & Nicobar Islands, Vol. 1. Botanical Survey of India, Kolkata.

KARTHIGEYAN, K., J. JAYANTHI, R. SUMATHI & J.S. JALAJ (2014): A review of the orchid diversity of Andaman & Nicobar Islands, India. *Richardiana XV*: 9–85.

KOSTERMANS, A.J.G.H. (1982): The genus *Carallia* (Rhizophoraceae) in Ceylon. *Acta Bot. Neerl. 31(4)*: 327–329.

MADANI, L. & K.M. WONG (1995): Tree Flora of Sabah and Sarawak. Vol. 1. Pp. 321–349.

MURUGAN, C., S. PRABHU, R. SATHIYASEELAN & R.P. PANDEY (2016): A Checklist of Plants of Andaman and Nicobar Islands. ENVIS Centre on Floral Diversity, Botanical Survey of India.

NAIK, M.C., M. BHEEMALINGAPPA, B. SWETHA, K. PRASAD, M.V. SURESH BABU & B.R. RAO (2014): Six species of Asteraceae, new distributional records for Andaman and Nicobar Islands, India. *Bioscience Discovery 5(2)*: 193–196.

RASINGAM, L. (2012): *Trichosanthes quinquangulata* (Cucurbitaceae) – A new record for India from Andaman Islands. *Rheedea 22(1)*: 09–10.

THE PLANT LIST (2013): Version 1.1. http://www.theplantlist.org. Accessed on September 21, 2016.

Recommended Citation

Balachandran, N., N. Dhatchanamorthy and W.F. Gastmans (2019): *Carallia borneensis* Oliver (Family Rhizophoraceae) – a new record to India from Andaman Islands. *J. Bombay Nat. Hist. Soc. 116*: 164–165. doi: 10.17087/jbnhs/2019/v116/105941

45. *SOLIVA ANTHEMIFOLIA* (JUSS.) R.BR. (FAMILY: ASTERACEAE) – A NEW GENERIC RECORD TO THE FLORA OF GUJARAT, INDIA[1]

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[1]Accepted March 13, 2019
First published: December 31, 2019 | doi: 10.17087/jbnhs/2019/v116/123308
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During a field trip to the Panchmahals district of Gujarat in January 2018, a few plants of a *Soliva* species were collected. After critical examination and going through literature, the identity of the specimens was determined as *Soliva anthemifolia* (Juss.) R.Br., family Asteraceae. However, in Gujarat, genus *Soliva* is not reported previously. Hence, it is a new generic record for the flora of Gujarat State. The voucher specimens (PKP 00704) are deposited in SPT Arts and Science College, Godhra, Gujarat, India. A taxonomic description of the species is provided.

***Soliva anthemifolia* (Juss.) R. Br.** in Trans. Linn. Soc. London 12: 102. 1817; Bhattacharyya in Bull. Bot. Surv. India 5(3 & 4): 375–376. 1963; B.D. Naithani in Hajra *et. al.,* Fl. India 12: 57–58. 1995. *Gymnostyles anthemifolia* A. Juss., Ann. Mus. Paris 4: 262. t. 61, f.1. 1804.

Prostrate annual stoloniferous herb. Stems up to 15 cm long, grooved, green, reddish at base, rooting from below the sessile heads. Leaves alternate, in basal rosettes, spathulate; leaflets, 2–3 pinnatifid, segments lanceolate-oblong, acute, thin, long, hairy. Flower heads present at base of stem, clustered in leaf axils, 2–3 mm in diam. (mature ones 0.8–1.0 cm in diam.). Involucre bracts many, in two rows, ovate-oblong, acute, 2–3 mm long, hairy; Ray florets in several rows, numerous, pistillate, fertile, villous near style, green, without corolla; Disc florets 7–8 flowers, tubular, 1.5–2.0 mm long, corolla long, pale yellow, lobes 3; sterile florets with pistillode admixed with fertile males; stamens 3; ovary brown, articulated; style curved. Achenes oblanceolate, 3 mm long and 1 mm wide, dark brown centre with light brown lateral corky wings, wrinkled margins, pappus absent but numerous white hairs present at apex.

The genus *Soliva* (family Asteraceae) is mainly distributed in Australia, South America, and Central America, with 12 species (Bhattacharyya 1963), but is found in many regions of the world. In India, *Soliva* is represented by only one species *S. anthemifolia* (Juss.) R.Br. which was recorded for the first time from "northern districts" of Uttar Pradesh, namely Ramnagar and Bahraich (Bhattacharyya 1963). Subsequently, it was reported from other parts of India. It is reported from Chhattisgarh and Eastern Uttar Pradesh, Dehradun, Delhi, and Western Uttar Pradesh, Eastern India, Himachal Pradesh, Jammu & Kashmir, Maharashtra, Rajasthan (Maheshwari and Singh 1972). After perusal of literature (Raghavan *et al.* 1981; Shah 1978), the collected specimen was found to be new to the flora of Gujarat State.

Flowering & Fruiting: December–April.

Distribution: Gujarat: Panchmahals district, near Tajpuri village, 22° 58′ 53″ N, 73° 51′ 40″ E, alt. 146 m above msl, 21.i.2018, PKP 00704, Department of Botany, SPT Arts & Science College, Godhra. Coll.: P.K. Patel.

Habitat: Wasteland, moist places, wetland areas, and in crop fields.

Note: The plant is usually seen growing in association with *Cynodon dactylon* L., *Lepidium sativum* L., *Oxalis corniculata* L., *Gnaphalium indicum* L., *Medicago polymorpha* L., *Melilotus indicus* (L.) All., *Ageratum conyzoides* L., *Anagallis arvensis* L., and *Chenopodium album* L.

ACKNOWLEDGEMENTS

The authors are thankful to Mr Naranbhai R. Baria, and Mr Akshay Nisarta for their constant support during field work. They are also thankful to Dr Suresh Chaudhari, SPT Arts and Science College, Godhra, Gujarat, India, for valuable suggestions.

REFERENCES

Bhattacharyya, U.C. (1963): *Soliva anthemifolia* R. Br. (Compositae) – a new record for India. *Bulletin of Botanical Survey of India 5(3&4)*: 375–376.

Maheshwari, J.K. & V. Singh (1972): *Soliva anthemifolia* (A. Juss.) R. Br. ex Less. (Compositae): an adventive species in Rajasthan. *J. Bombay Nat. Hist. Soc. 69(2)*: 452–453.

Raghavan, R.S., B.M. Wadhwa, M.Y. Ansari & R.S. Rao (1981): A checklist of plants of Gujarat. *Records of Botanical Survey of India 21(2)*: 1–127.

Shah, G.L. (1978): Flora of Gujarat State – Vols I & II. Sardar Patel University Press, Vallabh Vidhyanagar, 424 pp.

Recommended Citation

Patel, P.K., Vandana Vyas and A.V. Pandya (2019): *Soliva anthemifolia* (Juss.) R.Br. (Family: Asteraceae) – a new generic record to the flora of Gujarat, India. *J. Bombay Nat. Hist. Soc. 116*: 165–166. doi: 10.17087/jbnhs/2019/v116/123308

46. NOTES ON *CEROPEGIA ANJANERICA* (FAMILY: APOCYNACEAE): A CRITICALLY ENDANGERED AND ENDEMIC 'FLY TRAP FLOWER' OF NORTHERN WESTERN GHATS[1]

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[1]Accepted May 15, 2019
First published: December 31, 2019 | doi: 10.17087/jbnhs/2019/v116/119286
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Introduction

Genus *Ceropegia* L. (family: Apocynaceae), known for its curious 'fly trap' flowers, is represented by more than 260 taxa (The Plant List 2013) distributed in the Canary Islands, India, Madagascar, New Guinea and Northern Australia, Southeast Asia, Tropical Arabia and Africa, except the Mediterranean region (Meve 2002). There are 60 taxa of *Ceropegia* in India, concentrated in the Western Ghats and North-Eastern states (Kambale 2015), of which the majority are rare.

As part of a research project on floristic studies of the Anjaneri hills, the authors have visited the area frequently and documented more than 350 species of flowering plants. This area is known to be the type locality of the Critically Endangered and endemic 'fly trap' flower *Ceropegia anjanerica* Malpure, M.Y. Kamble, & S.R. Yadav (Malpure *et al.* 2006). After its discovery, the species has not been collected outside its type locality. Hypothesizing that this species may be present on the nearby rocky outcrops, we visited such outcrops at Brahmagiri, Harshgad, Kurung, and Kushegaon in a 60 km periphery of Anjaneri hill. During one such visit, we traced more than 100 mature individuals of *Ceropegia anjanerica* at Kushegaon ranges of Igatpuri *tehsil* (Nashik district), Maharashtra. Hence, we report the occurrence of this rare endemic from an additional locality in the present note. It is clearly indicated that extensive surveys are necessary to locate this rare and critically endangered species for a proper assessment of its status and distribution.

Ceropegia anjanerica Malpure, M.Y. Kamble & S.R.Yadav, Curr. Sci. 91(9): 1141. 2006.

Perennial tuberous erect herb. Leaves scabrous above, along midrib, and along margin; glabrous otherwise. Inflorescence an extra-axillary solitary flower; corolla 1.8–3.5 cm long; corolla tube up to 0.8–1.5 cm long, gradually dilated at base, funnel-shaped towards throat, slightly curved, greenish grey, striated with deep purple lines within, white otherwise, glabrous within; corolla lobes 1.0–1.8 cm long, greenish yellow, obovate, attenuate, finely pubescent throughout, connate at the tip, lobes reflexed. Corona biseriate, stipitate; outer corona of 5 bifid lobes, 2 x 2 mm, yellow, ciliate within and along margin; inner corona of 5 erect linear lobes, 2 mm long, alternating with outer corona. Follicles usually in pairs, *c.* 7 cm long, straight, tapering to a fine point, erect. Seeds *c.* 5 x 2 mm, ovate, oblong, comose; coma 1.0–1.6 cm long, white, silky.

Flowering & Fruiting: September–October.

Distribution: Anjaneri hills and Kushegaon ranges, Nashik district, Maharashtra, India.

Chromosome number: 2n = 22 (Gosavi *et al.* 2012).

Habitat: Grows at an altitude of 1,296 m in well-drained soil, in association with *Cyanotis fasciculata* (B. Heyne ex Roth) Schult.f., *Glyphochloa forficulata* (C.E.C. Fisch.) Clayton, *Ischaemum impressum* Hack., *Jansenella neglecta* S.R. Yadav, Chivalkar & Gosavi, *Justicia procumbens* L., *Senecio bombayensis* N.P. Balakr., and *Swertia minor* Knobl.

Notes: *Ceropegia anjanerica* has been assessed as Critically Endangered [CR B1ab(iii,v)+B2ab(iii)] by Pethe *et al.* (2015) who mentioned that local people have reported this species from the adjoining cliff called 'Navar-Dev', and further stated that the "sub-population lost due to improved accessibility". These observations are probably not supported by actual field studies by the authors, as there are no specimens cited in the article. As the species possesses comose seeds, its dispersal is easy in the surrounding cliffs. Therefore, extensive surveys are needed to locate a few more populations.

Specimen Examined: INDIA: Maharashtra; Nashik district, Igatpuri, Kushegaon, 10.ix.2017, S.S. Kambale, K.V.C. Gosavi & S. Golait, deposited in BSI, *SSK 1*.

ACKNOWLEDGEMENTS

Sharad S. Kambale thanks the Principal, Maratha Vidya Prasarak Samaj's Arts, Commerce & Science College, Tryambakeshwar, Nashik, for laboratory facilities. Sachin Golait thanks the Board of College and University Development (BCUD), Savitribai Phule Pune University, Pune for financial assistance to the research project "Studies on floral diversity of Anjaneri hill". The authors also thank Mr Raghunath and Mr Sonu for their help in field work.

REFERENCES

Gosavi, K.V.C., S.S. Kambale & S.R. Yadav (2012): *In*: IAPT/IOPB chromosome data 14. *Taxon 61(6)*: 1336–1345.

Kambale, S.S. (2015): Taxonomic revision of genus *Ceropegia* L. in India. Ph.D. Thesis, submitted to Shivaji University, Kolhapur.

Malpure, N.V., M.Y. Kamble & S.R. Yadav (2006): A new species of *Ceropegia* L. (Asclepiadaceae) from Western Ghats of India with a note on series *Attenuatae* Huber. *Curr Sci. 91(9)*: 1140–1142.

Meve, U. (2002): *Ceropegia*. *In*: F. Albers & U. Meve (Eds): Illustrated Handbook of Succulent Plants: Asclepiadaceae. Springer, Berlin, pp. 63–106.

Pethe, J., A. Tillu & A. Watve (2015): Threat status assessment of *Ceropegia anjanerica* Malpure *et al.* (Magnoliopsida: Gentianales: Apocynaceae) from Anjaneri Hills, Nashik District, Maharashtra, India. *J. Threatened Taxa 7(3)*: 6965–6971.

The Plant List (2013): Version 1.1. http://www.theplantlist.org/ Accessed on January 01, 2017.

Recommended Citation

Auti, Sanjay, Kumar Vinod Gosavi, Sachin Golait and Sharad Kambale (2019): Notes on *Ceropegia anjanerica* (Family: Apocynaceae): a critically endangered and endemic 'fly trap flower' of Northern Western Ghats. *J. Bombay Nat. Hist. Soc. 116*: 167–168. doi: 10.17087/jbnhs/2019/v116/119286

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Printed by Silverpoint Press Pvt. Ltd, 165, Kohinoor Estate, Tulsi Pipe Road, Lower Parel, Mumbai 400 013 and published by Honorary Secretary for Bombay Natural History Society, Hornbill House, Dr Sálim Ali Chowk, Shaheed Bhagat Singh Road, Mumbai 400 001, Maharashtra, India.

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Printed by Silverpoint Press Pvt. Ltd, 165, Kohinoor Estate, Tulsi Pipe Road, Lower Parel, Mumbai 400 013 and published by Honorary Secretary for Bombay Natural History Society, Hornbill House, Dr Sálim Ali Chowk, Shaheed Bhagat Singh Road, Mumbai 400 001. Website: www.bnhsjournal.org; Email: publications@bnhs.org/publications.bnhs@gmail.com